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ABSTRACT

Fieldwork provides an opportunity to reinforce previous class-based learning and presents students with an opportunity to encounter new ideas and practice new skills. In the K-12 classroom, however, the rhetoric-reality gap between the declared need for fieldwork and doing fieldwork is striking. This project seeks to narrow the gap between rhetoric and reality by providing K-12 teachers with guidelines for integrating fieldwork into the geography curriculum. The emphasis throughout the project is on strategies that are local, small-scale, easy to implement, and inexpensive. The project framework is comprised of three interlinked approaches: observation, investigation, and inquiry. These approaches represent a progression in skills from activities that are teacher-directed, qualitative, and prescriptive to those that are more student-directed, interactive, and open-ended. The guide includes thirteen step-by-step examples of fieldwork activities, addressing the National Geography Standards and the Advanced Placement Human Geography Course, in both physical and human geography for grades K-12 and the university level. It provides checklists for pre-field planning, reconnaissance of the site, preparation and training, data collection, and evaluation of the findings. The project guide is divided into the following chapters: (1) "Fieldwork in the Geography Curriculum: Filling the Rhetoric-Reality Gap"; (2) "Survey of the Literature on How Fieldwork Affects Learning"; (3) "Designing, Planning, and Implementing Fieldwork"; and (4) "Examples of Fieldwork." Contains extensive references, as well as many tables, figures, cartoons, and photographs. (BT)

A PATHWAYS IN GEOGRAPHY
Resource Publication

National Council for
Geographic Education

FIELDWORK IN THE GEOGRAPHY CURRICULUM:

FILLING THE RHETORIC-REALITY GAP

Gwenda A. Rice and
Teresa L. Bulman

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The PATHWAYS IN GEOGRAPHY series has been created by the Special Publications Advisory Board of the National Council for Geographic Education to support the teaching and learning of themes, concepts, and skills in geography at all levels of instruction.

PATHWAYS

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Dedication

To the teachers of the Oregon Geographic Alliance and their students who were instrumental in developing the activities in this book

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FIELDWORK IN THE GEOGRAPHY CURRICULUM: FILLING THE RHETORIC-REALITY GAP

Tell me and I will surely forget.
Show me and I might remember.
But make me do it, and I will certainly understand.
Tom Magliozzi of "Car Talk" on National Public Radio

Geographers have always recognized fieldwork as an important component of the geography curriculum. Fieldwork certainly provides an opportunity to reinforce previous class-based learning and presents students with an opportunity to encounter new ideas and practice new skills. Sauer (1956) noted that the "principal training of the geographer should come, where possible, by doing fieldwork." More recently, Gober (1997:1) has written of the importance of fieldwork to geography, noting that:

> most geographers have a deep connection with place, one that has drawn us to the field, one that we communicate to students, and one that binds us together as an intellectual community. At its very heart is our interest in real places, how they look, feel, and work. Fieldwork is fundamental to the way many geographers understand the world.

This perspective is often true at the college level, where programs specifically address field techniques and require students to do field-based projects. In the K-12 classroom, however, the rhetoric-reality gap between the declared *need* for fieldwork and doing fieldwork is more striking. The connections with the curriculum are often tangential and fieldwork becomes an add-on to class-

**Table 1.1.
Examples of Fieldwork Activities that
Address the National Geography Standards**

The World in Spatial Terms
- following directions and routes
- making sketches, sketch maps, models of places
- drawing mental maps of places before and after fieldwork activities
- analyzing different types of maps and photos of the local region before, during, and after fieldwork

Places and Regions
- what place are like
- what people do
- changes in places
- comparing own locality with other localities

Physical Systems
- identifying landscape features
- what weather and seasons are like
- where water comes from and how living things use it
- water flooding, eroding, and creating land

Human Systems
- where people live and why they live there
- why people move
- what kinds of transportation people use
- what kinds of journeys people make
- what uses people make of buildings
- what kinds of goods and services are available

Environment and Society
- how people have changed the environment
- how people might improve the environment
- identifying places that are vulnerable to pollution and need protection

The Uses of Geography
- identifying different points of view that influence development of policies to guide using and managing resources
- identifying local problems that have a spatial dimension and developing possible solutions

(Sources: *Geography for Life* 1994 and Catling 1995)

Table 1.2.
Advanced Placement Human Geography Content Outline

Geography

I: Its Nature and Perspectives
- A. Geography as a field of inquiry
- B. Evolution of key geographical concepts and models associated with notable geographers
- C. Key concepts underlying the geographical perspective: space, place, and scale
- D. Key geographical skills
- E. Sources of geographical ideas and data: the field, census data, etc.

II: Population
- A. Geographical analysis of population
- B. Population distribution and composition
- C. Population growth and decline over time and space
- D. Population movement

III: Cultural Patterns and Processes
- A. Concept of culture
- B. Cultural differences
- C. Environmental impact of cultural attitudes and practices
- D. Cultural landscapes and cultural identity

IV: Political Organization of Space
- A. Nature and significance of political boundaries
- B. Evolution of the contemporary political patterns
- C. Challenges to inherited political-territorial arrangements

V: Agricultural and Rural Land Use
- A. Development and diffusion of agriculture
- B. Major agricultural production regions
- C. Rural land use and change
- D. Impact of modern agriculture

VI: Industrial and Economic Development
- A. Character of industrialization
- B. Spatial aspects of the rise of industrial economies
- C. Contemporary global patterns of industrialization/resource extraction
- D. Impacts of industrialization

VII: Cities and Urban Land Use
- A. Definition of urbanization
- B. Origin and evolution of cities
- C. Functional character of contemporary cities
- D. Built environment and social space
- E. Responses to urban growth

room learning rather than an extension of it. For many teachers, fieldwork is an expensive and time-consuming undertaking to squeeze into an already overcrowded curriculum. The logistics are daunting, involving endless phone calls, coordinating permission slips, securing chaperones, scheduling buses, and accommodating other teachers' schedules. Fieldwork is perceived as no more than a *field trip*. Too often the "connections with the curriculum are tenuous and the field trip is viewed as a unique and isolated event occurring at the end of a course as a sort of summary and glorified school picnic (Rice, 1998: 1)."

The purpose of this project is to narrow the gap between rhetoric and reality by providing K-12 classroom teachers with guidelines for integrating fieldwork into the K-12 curriculum. Using the Lonergan and Anderson (1988:64) definition of the field as any place "where supervised learning can take place via first-hand experience, outside the constraints of the four-walls classroom setting," and recognizing the difficulties for K-12 teachers of organizing fieldwork, the emphasis throughout this work is on strategies that are local, small-scale, easy to implement, and inexpensive.

Our goal is to demonstrate the power and potential of fieldwork for learning geography and to present fieldwork as a learning event that is an integral and indispensable component of the curriculum. We present fieldwork as an opportunity for teachers to design activities that address the National Geography Standards (Table 1.1) and the Advanced Placement (AP) Human Geography Curriculum (Table 1.2) and to provide arenas for students to hone their geographic skills.

Central to the project is a developmental conceptual framework for thinking about fieldwork (Table 1.3). adapted from work by Bland *et al.* (1996). This framework comprises three inter-linked approaches—observation, investigation, and inquiry. These approaches represent a progression in skills from activities that are teacher-directed, qualitative, and prescriptive to those that are more student-directed, interactive, and open-ended. Observation activities, for example, include sketching or photographing the landscape, taking a guided tour of the school grounds, Central Business District (CBD) or local historic district, or following a trail. Examples of the investigation approach include measuring such phenomena as the micro-climate components of a classroom, store frontage and building heights in the CBD, traffic counts at peak periods or stream flow in a local creek. It could also involve conducting surveys to determine shopping patterns, pedestrian movement, or journeys to school, and mapping land use at various locations. More open-ended inquiry processes might include generating and testing hypotheses. Other inquiry examples include evaluating access for disabled students in the school, investigating litter problems in the school vicinity, or assessing the need for a new traffic light in the local neighborhood (Rice 1998). Teachers can use each approach independently or as a continuum of increasingly complex but interdependent activities as students move from observation to investigation to inquiry. The processes outlined in Figure 1.1 illustrate this interdependence and provide an excellent way for students to learn and use the five geographic skills: asking geographic questions, acquiring geographic information, organizing geographic information, analyzing geographic information, and answering geographic questions. Tables 1.4 and 1.5 outline a developmental progression in fieldwork and the skills that are learned at each level with examples of fieldwork topics for both urban and rural environments.

Table 1.3. Framework for Conducting Fieldwork

	Observation ⇔	**⇔ Investigation ⇔**	**⇔ Inquiry**
Type of Activity	look and see	field study	field discovery
	look and listen	field measurement	generating hypotheses
	guided tour	investigating	hypothesis testing
	field demonstration	model testing	problem solving
Characteristics	passive transmission	active	interactive
	teacher-centered	teacher-led, student-centered	student centered interpretive
	specific focus	systematic	open-ended
	qualitative	quantitative (data-oriented)	qualitative and quantitative
	observation-oriented	measurement-oriented	outcome-oriented
	information-based	activity-based	discovery-based (interpretive)

(Adapted from Bland *et al.* 1996)

In designing effective and safe fieldwork, teachers have to ask many questions and make many choices (see Chapter 3). They need to consider the skill level of their students and the difficulty of the tasks they wish them to perform as well as the level of supervision they need. Teachers also need to consider the geographical idea and concept to be studied and how it fits into the curriculum (Rice 1998). For fieldwork to be successful, planning is essential. This project outlines key planning steps for designing, implementing and follow-up, including checklists for pre-field planning, reconnaissance of the site, preparation and training of students in the necessary skills, conducting the fieldwork and data collection, and follow-up and evaluation of the findings and debriefing. Drawing from experiences working with teachers and K-12 students, the final section includes examples of local fieldwork activities in both physical and human geography for different grade levels. These activities are easy to implement, illustrate the approaches in the framework, and address the National Geography Standards and the AP Human Geography Curriculum.

Figure 1.1 Processes in Fieldwork

question/brainstorm
formulate hypotheses
test hypotheses
problem-solve
ask new questions

↑

measure
tabulate
survey/sample
calibrate
map

↑

observe
listen
write
draw/sketch
photograph
follow a trail

(Adapted from Bland *et al.*, 1996.)

Table 1.4 Progression in Fieldwork: Pre-school to Grade 5

	Pre school	Grades K-1	Grades 2-3	Grade 4-5
Rural Environment	Line map Journey to school Land use map Journey or transportation Follow the stream	Line map Journey around school Housing types Land use maps School grounds-location of facilities Imaginary maps My ideal farm Large-scale maps	Field sketching Rural landscape assessments Development—from partially drawn to own drawing Wildlife area Location—new car park or play area Water environment—river, lake, pond, stream	Location of supermarket Mapping—land use and routes Research Weather Micro-climate sites, aspect Environmental change Restoration of damaged environments
Skills Development	Directed questions Data handling Technical, location language Data handling	Questions—What if? Why? (adult scribe) Observations Similarities and differences Data handling Technical, locational language Own symbols Freehand symbols Freehand symbols, keys Peer evaluation—group work Make models	Directed questions Annotations/Follow methods Reasoning and discussion—plan and do Scale plans—measurements Issues-management Record data—analysis Methods of presentation Making models Directed questions—Hypothesis, What if? Data handling	Prediction—group selection of three sites Different maps—keys, function of maps, design? Collect and analyze data Awareness of issues—empathy Make deductions, draw conclusions Use of instruments, technical skills Cross reference over time, other localities
Urban Environment	Line map Shopping mall Journey to school Land use map Ground floor use Journey or transport Delivery route—food Highway or railroad map	Line map Journey around school Housing types Land use maps School grounds or park location of facilities Retail plan within store—fresh or canned or frozen Imaginary maps My ideal retail center or play area Large scale maps	Field sketching Urban landscape assessments Development—from partially drawn to own drawing Wildlife area Location—new car park, crossing area or play area Water environment—river	Location of supermarket Mapping—land use, routes Research Role play of proposal Weather Micro-climates—site or aspect Environmental change Restoration of damaged environments

(Adapted from "Progression in Fieldwork," undated, Field Studies Council)

Table 1.5 Progression in Fieldwork: Grades 6-12

	Grades 6-8	Grades 9-10	Grades 11-12
Rural Environment	Urban or rural land use transects Park —footpath erosion, visitor use parking River study—surface speeds in different parts of the stream. Water quality, erosion of banks Small rural town—old or new Gentrification, vacation homes rentals, changes in service provision	River study—velocity variations downstream and within channel cross-sections Rural transect—land use mapping Farm surveys Farming, forestry, recreation land use conflicts, especially within national parks Land use—commercial, recreation funding options Rural-urban hierarchy services	Tourism vs. historical preservation—potential conflict Land use mapping—association within other factors (slope, geology, etc.) Coastal forms and processes River forms and processes, friction Relations between other variables. Implications for channel or flood management Waste management
Skills Development	Mapping—land use areas and transects Measuring: Use of keys and legends Increasing breadth of techniques Identifying chemical substances—kits, strips Data logging Environmental assessment and personal perceptions	Monitoring change, data logging, sediment sampling and using questionnaires Mapping land use Using technology Role playing Choosing appropriate techniques	Environmental impact assessment Soils—depth, textures, pH. Moisture Sediment—size shape, and sorting Identifying plants and animals Ecological techniques—transects, sampling strategies Surveying—river gradient or slope. Beach profiles Development—using questionnaires Techniques to explore environmental variables and justifying choices
Urban Environment	Macro-climatic studies in local area, wind speed, acid rain Land use transects through area, maps, etc. Development models of growth and development over space and time Spheres of influence—environment traffic counts, noise meters	Contrasting neighborhoods—environmental assessment Structure of settlements—transects land use maps Map rails in parks Bypass of relief roads—studying issues, effects. Conflicts Park land use—planning in cities Rural-urban hierarchy—settlement functions Urban services—provision in different sizes of settlements	Settlement—structure and change, clustering of retail outlets, hierarchy prime land values Planning—e.g., pedestrian accessibility, urban pollution Tourism—facilities and provision: accessibility. Parking, environmental change, local reaction Issues and variety of response for solutions Siting new development—transect studies Waste management

(Adapted from "Progression in Fieldwork," undated, Field Studies Council)

2

Survey of Literature on How Fieldwork Affects Learning

> The real voyage of discovery consists not
> in seeking new landscapes but in having new eyes.
> Marcel Proust

Among geography teachers, fieldwork has long been a popular teaching strategy. Many authors have advanced rational arguments for the integration of fieldwork into the curriculum as a way to bring about learning in both affective and cognitive realms (Boardman 1974, Kaplan 1974, Marotz and Rundstrom 1986, McEwen 1996). Sauer (1956: 290) wrote that fieldwork promotes "a feeling of personal discovery and curiosity." Other geographers view fieldwork as an opportunity for students to engage actively in problem-solving and to experience firsthand how geographic approaches to problem-solving apply to real world situations (Nordstrom 1979, Marotz and Rundstrom 1986, Jackson *et al.* 1997). Rynne (1998) sees fieldwork as going beyond merely reinforcing class-based learning to providing opportunities for students to encounter new ideas and practice new skills.

Fieldwork also provides opportunities for students to conduct original research and make geographic study relevant (*Geography for Life* 1994: 42-43). At the high school and undergraduate levels, fieldwork is important for developing in students the skills to be qualified practitioners in all aspects of geography since much great research in the discipline is based upon fieldwork (Gold 1991). Fieldwork also has a role as a vehicle for integrating and illustrating theoretical concepts and models taught within the discipline (Kern and Carpenter 1986, Lonergan and Anderson 1988, McQueen *et al.* 1990, McEwan 1996). As Boardman (1974: 160) noted, "many models featured in everyday school geography bear little resemblance to the everyday observable world, a world which in most instances begs to be explored and examined at first hand in the field." Fieldwork links geographic concepts introduced in class and real-life application of these concepts.

Both theoretical and empirical research support, though limited, a field approach to learning. Piaget advocates that providing direct experiential, relational opportunities assists in and enhances learning (Siegler 1986). Novak (1986: 2) contends that direct experience with real objects and processes can "give form and meaning to primary concepts and facilitate differentiation and application to more complex concepts." Other research (Wiley and Humphrey 1985, Kern and Carpenter 1986, Wheater 1989) suggests that fieldwork is particularly effective in fostering student understanding of abstract topics and higher level concepts that can be easier to teach in the field than in the class. Fieldwork, therefore, in addition to enhancing observation and data collection skills, enables students to connect concepts (such as land-use patterns) with the student's personal observation and experiences (mapping land-use change). This is particularly true for younger children who are acutely aware of their environment. They are naturally curious about places and eager to explore them. Fieldwork for this age group can be very useful in developing acquisition of geographic concepts and vocabulary (Milner 1996).

An important value of fieldwork is in the affective realm and the research generally supports this. Studies by Ignatiuk (1978), Smith (1979), and Kern and Carpenter (1984) found that a fieldwork approach has a pronounced positive influence on student attitudes toward environmental concepts and on student motivation and enjoyment. Barrat and Hall (1998) found that fieldwork builds students' self-reliance and gives them confidence in their new abilities. Fieldwork can improve student-staff relations and encourage the development of greater social integration of the student cohort. Fieldwork can be an effective way to enhance social skills for students with special needs. A study by Shelly and Owen (1999) found that using outdoor learning experiences for students with special needs increased motivation, self-esteem, and levels of both cooperation and independence.

The empirical evidence for the effectiveness of fieldwork in bringing about cognitive learning is less well documented, particularly for geography (Wise and Okey 1963, Mackenzie and White 1982, Jackson *et al.* 1997). The work of McKenzie and White (1982) provides some valuable insights into the nature of learning and fieldwork. They found that students who were active in data collection and were provided with experiential activities, retained related subject matter more effectively after twelve weeks than those who were passive recipients of information. Their work indicates the need for teachers to design fieldwork activities that are meaningful and directly connected to the curriculum.

Gagne and White (1978) and Wittrock (1994) contend that, for learning to be effective, new information needs to be related to prior knowledge. Rynne (1998:206), building on these ideas, recommends that "deliberate efforts need to be made in designing fieldwork that gets students to form 'episodes', or memory events, and to link them with other knowledge. " Topics covered in the field need to be taught and discussed before the students go into the field in order to provide a context for the fieldwork. Without this context, students' abilities to process new material will be inhibited. In addition, teachers must use and incorporate the information gathered in the field into subsequent classroom learning. Otherwise, "it will remain isolated and not become part of the students' long-term memory stores (Rynne 1998: 207)." This indicates the need for careful planning and structured activities—both prior to and subsequent to the fieldwork, in the briefing and debriefing components. Howie (1974: 33) advocates the need for extensive and structured programs of advance organization in order to gain maximum benefit from field experiences including "teacher-in service training, classroom development of advance organizers, the field experience, and follow-up in the classroom, with further application and conceptualization." Research by Genera (1981) and Falk and Bailing (1982) confirm that preparation at several levels leads to successful fieldwork. In both studies, student cognitive gain increased significantly with the use of pre-trip materials and preparation. Desinger (1984) supports this view by suggesting that out-of-classroom learning experiences are not sufficient in themselves to produce significant cognitive gains but ample evidence indicates that in-the-environment instruction is effective in promoting and achieving cognitive gain when effectively planned and staffed.

Fieldwork can also be good preparation for the workplace in the context of the *learner-practitioner activity* (Hale 1986, Fryer 1991, Garver 1992, Slater 1993). The experience can prepare students for work that is specific to the discipline such as planning or resource management. Fieldwork can also enhance a range of transferable skills such as communication and presentations skills, group and leadership skills, organizational and problem-solving skills. For example, in Oregon, *service learning* is an important component of the high school level Certificate of Advanced Mastery (CAM). Schools place students with organizations (local businesses and services, government, local, state, and national agencies, and planning departments) and students work as an employee or intern of the organization for a period of time. As Kent *et al.* (1997: 318) have noted, teachers should see these opportunities "a new and important format for fieldwork in geography." Numerous possibilities are also available for enhancing concepts taught in the Advanced Placement (AP) Human Geography curriculum (Table 1.2) in this type of fieldwork.

Another avenue for fieldwork in the curriculum is the community service or community action component that many schools are now requiring for graduating seniors. In a high school in Philomath, Oregon, community service is part of the geography curriculum and teachers and students used it as a vehicle for fieldwork and to enhance geographic skills while meeting the community service requirement. At a middle school in Dundee, Oregon, students collected traffic survey data within the context of a geographic study of their town and in response to a refusal by the Oregon Department of Transportation (ODOT) to install a traffic light near an elementary school. The students presented their fieldwork results to the community and to ODOT and, three weeks later, ODOT approved the light. The Governor of Oregon even visited the school to congratulate the "traffic light geographers (Zirschky 1989)."

Table 2.1 Objectives for Fieldwork

Subject-specific Objectives:

- teach specialist field techniques and research methods;
- use experimental data to solve specific problems;
- demonstrate theory in practice;
- foster awareness of other places and cultures;
- expose students to a variety of approaches to the discipline;
- provide an opportunity for independent research by students;
- provide real material and context for geographic questions;
- enhance analytical and interpretive skills;
- teach students to observe, measure, and record.

Transferable Skills:

- provoke students to ask question and identify problems;
- stimulate independent thinking;
- motivate and teach students to become self-directed learners;
- enhance communication and presentation skills;
- develop group-work skills;
- develop leadership skills;
- become aware of the parallels between skills involved in carrying out fieldwork and those in employment in the real world.

Socialization Skills and Personal Development:

- stimulate and enhance enthusiasm for study;
- develop respect for the environment;
- encourage and develop social integration among students;
- enhance staff-student relations.

Modified from: Kent, M. *et al.* (1997). "Fieldwork in Geography Teaching: A Critical Review of the Literature and Approaches." *Journal of Geography in Higher Education* 21(3): 320.

In Table 2.1, Kent *et al.* (1997) identify objectives related to fieldwork in three broad categories: objectives that are specific to the discipline such as (a) integration of the subject from theory into practice and training students in observation, measurement, and recording; (b) objectives that deal with transferable skills such as group and leadership skills; and (c) those objectives that are in the affective realm that address socialization and personal development including stimulation and enthusiasm for learning and development of respect for the environment. The growing body of research provides evidence for usefulness and importance of geographic fieldwork in the curriculum, combined with the growing demand for community-based and service-learning programs, and means that the opportunities and avenues for fieldwork in the K-12 curriculum are likely to grow. What teachers will need, given the practical constraints of doing fieldwork, are field activities that are local, small-scale, easy to implement, and inexpensive to accomplish.

3

Designing, Planning, and Implementing Fieldwork

Nothing is more miserable or more profitless than the day in the country in which the teacher tries to lead along a route he does not know, through country of which he is ignorant, a group of children who are being given nothing to do but walk.
From a 1950 British teaching manual

In designing and planning fieldwork, the teacher needs to create an activity that will introduce or reinforce geographic concepts, demonstrate data collection and analysis techniques, and develop presentation methods and skills that will help reinforce the concepts. The design of a particular field activity is a function of two essential elements: the educational objectives teachers wish students to achieve and the practical limitations of time, materials, sites, and group size. Fieldwork planning is the completion of all the steps necessary to implement the design. The specific stages of fieldwork include:

Designing Fieldwork
- Activity selection
- Site selection
- Inclusiveness: Fieldwork for all students with special needs

Planning Fieldwork
- Document (Archival) preparation
- Site preparation
- Briefing and orientation

Doing the Fieldwork: Data Collection
- Field logs and data sheets
- Field equipment

Data Analysis and Presentation of Results

Assessment

Designing Fieldwork

The teacher needs to make the initial assessment of whether field activity is appropriate and connects closely to the curriculum and teaching goals. Once a teacher decides that fieldwork is the appropriate strategy to enhance learning, the teacher must choose which fieldwork is appropriate. The pedagogical questions that govern the choice of a specific activity include:

- Why am I offering this particular activity?
- What are the learning outcomes? Which geography standards and skills do the learning outcomes address?
- What is the focus of the activity?
- Why is this particular activity appropriate?
- Are the students ready for the activity?
- Have the students previously experienced the particular activity or key aspects of it?
- What knowledge and skills does the activity require and how will this activity provide them?
- How will the activity stimulate student interest?
- How will the students work (individually or in groups)?
- What equipment and materials will we need?
- How will we assess the experience?
- Will the students have the opportunity to apply what they have learned through activity in other settings? If so, how will they accomplish them?

Assuming that fieldwork is appropriate in the context of the learning goals, the teacher must clearly define and demonstrate how closely the objectives of the fieldwork connect to the learning objectives of the classroom curriculum. The teacher can select a field activity that addresses particular geography standards, or can create an activity that specifically relates to and enhances classroom learning. The type of fieldwork will depend on the level of student knowledge and preparation that falls along the continuum from observation to investigation to inquiry (see Table 1.3). As students learn to ask increasingly complex geographic questions, they will move from questions of observation to questions of investigation and inquiry, and the fieldwork they engage in will reflect this increasing complexity (see Tables 1.4 and 1.5).

Activity Selection:

Observation Fieldwork is relatively easy to organize and conduct since it is rooted in the basic questions of: What do you see (hear, smell, touch)? and How do you describe it? Observational activities can intensely engage young students who are just learning how to articulate, in words and drawings, what they see in the world around them. For more mature students, observational activities may not be as engaging but the skill is as critical and can be made more challenging if you expect students to compare findings or focus on specific follow-up questions. Observation fieldwork should always allow for independent observation: students need to use their senses and describe what they see, hear, smell, taste and touch, without the bias of previous observations or conclusions by others.

In observation fieldwork the questions students address are fairly straightforward. For example, if students are studying *riparian* (related to or living or located on the bank of a natural water course or water body) vegetation, the basic observation questions might be: What kind of vegetation is it? How close is the vegetation to the stream? How dense is the vegetation? Very young students might be addressing questions as simple as: What colors are the plants? How tall are the plants? Do the plants have seeds? Do different plants have different odors? For very young students the questions might relate simply to shapes or colors (see Fieldwork Activity #1). No matter how basic (or complex) the question, the essence of observational fieldwork is that the students use their senses to take in the landscape and compare their findings with previous knowledge.

Investigative fieldwork moves the students along the continuum to a point where they are engaging in methodologies, making comparisons, and attempting to find answers to more complex questions. Students may employ particular methodologies, directed or controlled by the teacher. Students may speculate about processes that they cannot observe directly, but that they may discern from the data. For example, investigative fieldwork on riparian vegetation may ask: How does the riparian vegetation

1. Using all the senses in fieldwork: Ashland, Oregon middle school students.

differ from local non-riparian vegetation? Does riparian vegetation seem to prefer saturated soil or well-drained soil, and why? Does the vegetation vary with the slope of the river bank? Investigative fieldwork usually involves measurement of, for example, relative size, shape, number, and rate of various observations.

Inquiry fieldwork involves students in the methods of carrying out fieldwork. Students may help design the research questions, formulate hypotheses to be tested in the field, and select the field sites. Students studying the riparian zone may ask questions such as: How will stream channel dynamics affect the location, density and type of riparian vegetation? How will upstream and upslope land use affect riparian vegetation? The open-ended nature of inquiry fieldwork will often lead to discovery-based interpretation—and more questions.

2. Investigation of wetlands vegetation

In designing fieldwork, teachers face many questions and choices, from the pedagogical to the practical. Kent *et al.* (1997) have identified and summarized recent research on the several points that teachers should consider in deciding, between the classroom and the field, which are the most suitable teaching and learning strategies:

- Deep knowledge of a locality seems to be most effectively and easily acquired through multi-sensory experience and participation in activity. Although this form of discovery is holistic, it requires a high degree of student autonomy and can be time-consuming.
- The sheer diversity of experience available in most field activities means that if a specific learning outcome is desired, teachers must carefully control and focus some aspects of the fieldwork.
- Field preparation (supporting materials, maps, and briefings) has a significant affect on the success of fieldwork, but teachers need to structure it to challenge, not spoon-feed, students.
- Research has proved that inquiry-based fieldwork is a particularly effective vehicle for learning and for deepening understanding, but poor preparation can limit its effectiveness.
- Students can acquire field skills only though direct participation.
- Contact with practitioners in the field can provide students with insight into the research process, and increase student motivation and achievement.

The practical variables that govern the choice of fieldwork are:

- The nature of the location and environment of the fieldwork
- The distance from school
- The duration of the field activity
- The preparation of the students for the fieldwork
- The age and size of the class
- The number of staff (parents, teachers, and other chaperones) involved, and their level of knowledge of the field activity
- The resources needed (such as field equipment)
- Access and opportunity at the field site for all students
- Weather restrictions

Answering these questions collectively will guide the teacher to the field activity that best addresses the specific learning objective.

Site Selection:
Teachers often associate fieldwork with the complicated logistics of transport vehicles (from school buses to family vans), camping gear, kitchen gear, and other issues associated with long-term or distant fieldwork. Teachers can help students perform fieldwork, however, within walking distance of school. Local area fieldwork can even include the school building and school yard, which can alleviate many problems often connected with more ambitious fieldwork in distant locations. An audit of the local area for fieldwork involves appraising the area in and around the school to identify sites which are accessible for fieldwork, which students can study using photographs, maps and other available data as well as the specific planned fieldwork (Catling 1995). Teachers need to address safety issues (see below), especially pedestrian access and road traffic.

Inclusiveness—Fieldwork with students with special needs:
Teachers can design fieldwork to ensure that all students have appropriate field experiences, whether the students are disabled, are just beginning to learn English, or are especially talented in geography. Students with special needs share in the benefits of fieldwork along with other students. Shelley and Owen 1999) demonstrated that using outdoor learning experiences for children with special needs increased student motivation, self-esteem, and levels of both cooperation and independence. Teachers can easily provide field opportunities for students with special needs in many cases. For example, in engaging students in basic field observation skills, allowing the students to sketch findings as well as write about them can enhance the experience for children with dyslexia or other reading disabilities. Similarly, using symbols as well as words in mapping activities can help the dyslexic or reading-challenged student (Nichols and Greenwold 1999). Activities designed to be inclusive of all students need not limit or detract from the field experience. For example, engaging students in activities that require the use of senses other than sight can improve sighted-students' skills as well. Multi-sensory fieldwork, such as evaluation of traffic noise patterns, benefits all students. Students should learn to use not only eyes but also hearing, smell, taste, and touch.

Teachers can best achieve the process of inclusion if they have the support of school administrators and colleagues in preparing and carrying out fieldwork in situations that can meet the needs of all students. Such support can range from allocating time in the curriculum for fieldwork to helping secure and fund vans for students with disabilities. The teacher's primary work in ensuring inclusiveness involves planning for the individual student within the context of the field activity. For example, is the site wheelchair accessible? Can disabled students use the particular field instruments with relative facility? Can the instruments be adapted, or can the student be given an equally important role to play in data gathering, such as recording the readings, or taking a leadership role in assigning other students to particular tasks or instruments? Having all students work together in fieldwork will help the able-bodied students to realize the talents and capabilities of their challenged peers.

In addition, the nature of field study itself can enhance student involvement by some traditionally uninvolved students. Research in environmental fieldwork shows that socio-economically disadvantaged students are often alienated by the way teachers present geography and environmental science subjects (Padgett 1994). Involving students in field investigations directly related to their communities [e.g., lead (Pb) contamination studies] can increase participation and motivation among those students in the disadvantaged group.

For non-native speaking students, fieldwork can provide exciting opportunities to learn in an environment where the focus is on experiential and hands-on learning. Students can learn not only through active participation but can describe what they observe through sketches, rather than words, eliminating the barriers of unfamiliar vocabulary and grammar. As sketchers or sample collectors, the students share equally in the responsibilities in the field, and become full participants.

In those situations where a class has students who are particularly gifted in geography, fieldwork can provide a challenging opportunity for them to extend their learning. Teachers can give these students key responsibility for creating hypotheses, designing research, and documenting research in preparation for the entire class going into the field. Teachers can also give students opportunities for independent projects, where an open-ended context may help them develop research questions and hypotheses and test them in the field.

In essence, fieldwork provides an opportunity to allow students to work in groups at a level particularly appropriate to each individual's skill and knowledge level.

Planning Fieldwork

After the teacher designs an appropriate field activity, the next step is specific planning for the implementing the field activity. Although the teacher has a significant portion of the planning responsibility, students can also participate in some components of planning. Broadly speaking, teachers can divide planning into three components: document (archival) preparation, site preparation, and briefing and orientation.

Preparation for fieldwork involves planning a calendar, collecting documents, and preparing students to make observations, use field equipment and collect and present data. How many of each of these components you will require is a function of the specific field activity and the students' maturity.

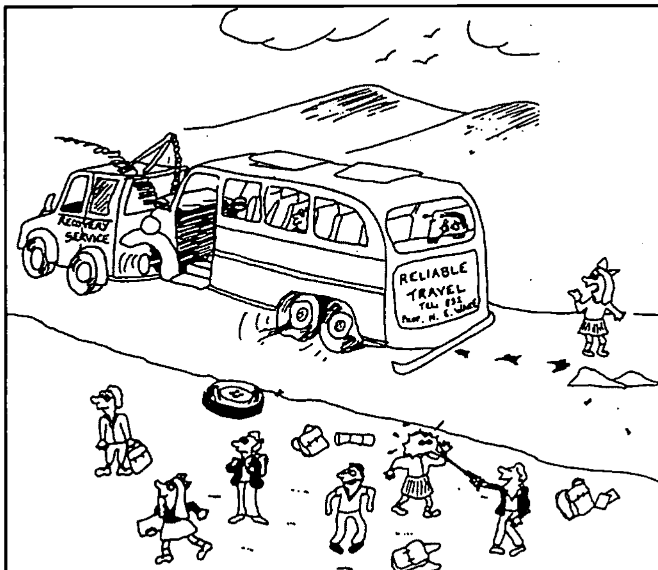
The calendar for fieldwork should include time for in-class discussion of the fieldwork, practice with equipment and data collection, and discussion and presentation of results. Although some field activities can incorporate all three in the span of a single class session, most fieldwork requires anywhere from several hours or classes to several weeks to complete.

Document Preparation: Both students and teachers, especially at the upper grade levels, can perform document (or archival) research, from collecting maps and brochures to reading relevant literature. Materials can come from libraries, the Internet, previous classes (especially if a teacher is doing a longitudinal study over a period of years), oral histories, and classroom texts. From documents students can get a sense of the field site and of the skills needed to do the fieldwork. For example, by using maps students can trace the route to the field site and identify key features at the field site. Young students can learn to identify landscapes and features of the built environment, and locate them on a map. Such preparation can also help students to recognize and identify map symbols. With sufficient guidance students can prepare their own field manuals and data sheets.

If the teacher plans to bring archival material into the field, consider protecting it against the elements. For example, laminating maps will keep them dry, and enable them to be used again and again. A less expensive alternative is to cover documents with cellophane.

Site Preparation and Reconnaissance: Site preparation involves ensuring that you have obtained appropriate permissions, the site is accessible when you need it, and you have tested and confirmed the transportation plan. Whenever possible, do a dry run (practice exercise)! If students will be collecting samples from the site, make sure permission has been obtained. If you require access to public land, you should confirm that public access is available at the site on the dates needed. It helps to call the relevant agency to confirm this information; roadwork or maintenance programs can block access and spoil the best-laid plans. Plan the timing of your site visit around tides, drawbridge openings, or whatever else might be along the route or at the site. Unscheduled road closures and vehicle breakdowns are difficult to plan for; teachers must fall back on ingenuity and the ability to deal with the unexpected.

If private land is involved in the fieldwork, obtain permission to go onto the land well ahead of time. Owners are often enthusiastic about supporting school fieldwork and can provide on-site assistance and information to students. Teachers must advise students to treat the land, whether public or private, with respect. Enthusiastic thank-you letters to landowners from students are not only considerate but can go a long way toward ensuring access for future classes.



(Source: Jay 1987)

Plan realistic itineraries and routes. A common problem is underestimating the amount of time fieldwork takes. Although a dry-run can greatly facilitate planning travel time, only when you are in the field with the students can you assess how much time you will need to accomplish your work. Plan to take more time than you think you will need! If students with special transportation or other needs are in the class, you must plan additional accommodations for them to ensure their full participation in the fieldwork.

Another critical element in the reconnaissance involves estimating group sizes and numbers of groups. Often this is a function unrelated to site and more closely related to available staff. The number of chaperones (teachers, parents, pre-service teachers, and staff) may determine how large a group, and how many sub-groups, can go into the field. Some school districts have set ratios of number of pupils per chaperone, which often varies by grade level. Teachers need to check the school and district guidelines. In addition, some sites may also restrict group sizes. For example, many federal wilderness areas limit the size of groups to no more than 12 people; often buildings and museums limit group size—particularly older, historic structures that tend to have small rooms.

Students usually bring food and drink for all-day fieldwork, but an extra water supply can be helpful. For long field days, plan ahead for bathroom stops. Vehicle refueling stops may be necessary if the fieldwork is not local. Teachers need to identify and comply with whatever permissions and safety measures the school requires (such as parental signatures, and at a minimum, a basic First Aid kit for bee stings and cuts should be available in the field). Brief both staff and students on safety issues (see below). If necessary, make finance and insurance arrangements (check district and school guidelines).

Briefing and Orientation: Preparation for fieldwork should give students the opportunity to explore the requirements you expect from them in the field and to acquire knowledge and skills necessary to carry out the fieldwork (Kent *et al.* 1997). At this stage in the fieldwork it is important to make sure the students see the link between the fieldwork and the curriculum so that fieldwork does not become an *add-on* or *prize.* Briefings and orientations, including practice fieldwork, can increase the educational effectiveness of fieldwork. Hence, briefings and orientations should establish a familiarity with the geography of the field site, and understanding of the key objectives of the fieldwork, and a sense of preparedness and safety. Orion *et al.* (1986) and Falk *et al.* (1978) have suggested that the novelty of the field site, the students' previous familiarity with the project, and the students' previous outdoor experience influence students' ability to learn in the field. To the extent a student gains familiarity with the site and practical outdoor skills (including safety), the more the student can focus on the fieldwork at hand. Students need a clear understanding of the objectives of the fieldwork and analysis. They need to understand the overall objective, such as analysis of riparian vegetation, as well as discuss key questions related to each component of the field activity prior to going into the field. Assign students responsibilities as individuals or as sub-groups. Students will begin to think about what they are likely to encounter in the field and will begin to understand how the data collection relates to the objectives.

Pre-fieldwork orientations, where you introduce students to the *lay of the land* and have an opportunity to ask questions, will help give students a sense of familiarity with the geography of the site and the surrounding area. Discuss basic information such as dress, equipment and food, along with how to conduct themselves in the field. Students may be fearful or uncomfortable in unfamiliar settings. City students may fear going into a forested setting for the first time, may be afraid of animals or of getting lost, or fearful of excessive noise or traffic (such as rural students in a city center for the first time), or concerned about the dirt and muck often encountered in fieldwork (Bixler *et al.* 1994). Such fears and discomforts pose barriers to learning. They distract students' attention from the fieldwork and consume valuable time as teachers need to correct misconceptions or over-inflated concerns. Students concerns can be quite exotic and unexpected, especially those of younger students. One of the authors encountered this with a group of Oregon elementary students who were doing fieldwork in a city forest. One third-grade girl became nearly panic-stricken as the group walked into a stand of trees, and she began clinging (with great force!) to the teacher's jacket. It turned out that the young student, who was from India and had only recently arrived in the United States, was absolutely convinced that a tiger was going to leap out from the forest, something her parents had warned her about repeatedly in their town near a game preserve in India.

The orientation process can alleviate many of the fears and concerns of students simply by letting students know in advance what they are likely (and not likely) to encounter. Once in the field, you can often dispel discomforts by example. The teacher who fearlessly wades into the muck, or shows no hesitation in holding slimy creatures serves as the ideal role model for fieldwork!

3. Students from Jefferson Elementary School, Corvallis, Oregon, study Dixon Creek that runs adjacent to their school.

Fieldwork Safety: Teachers should brief students on safety well in advance of the fieldwork, including advising students to behave responsibly and not put themselves or others in danger. Discuss appropriate clothing and footwear, and where necessary advise students to inform you of special diet or health restrictions (such as asthma). Discuss concerns and issues with parents of disabled students; be informed about the students' physical needs before going into the field.

Anticipate, and advise the students about weather, water and terrain hazards, and animals (from bees to snakes to domestic dogs and cats). Students may need advance briefing in order to prepare. For example, if the fieldwork involves negotiating difficult terrain, students may need to purchase proper footgear. Just before departure remind students about immediate hazards such as traffic. Students are more visible to traffic if they wear bright-colored clothing. Young students should use a buddy system and wear name tags (with the school information) in case they stray from the fold. Safety briefing should include safe use of field equipment such as knives and rock hammers. Although low student to staff ratios can ensure higher degrees of safety, it is not always possible to have a large staff. Encourage students to support each other and to cooperate in ensuring field safety.

Brief the staff as well about safety and student conduct. Allocation of responsibilities should be clear, and advise students that all staff (including parents and volunteers in the field) have authority to assist the teacher in the field.

Observation and Instrument Briefings: Preparing students for fieldwork includes teaching them to make observations and to use field equipment. Some fieldwork is specifically designed to develop or enhance observations skills (see Fieldwork Activity # 2) but all fieldwork involves using these skills, and students need at least a basic preparation before going into the field if time in the field is to be well spent. Depending on grade level and the planned fieldwork, use different activities to hone students' observation skills. For example, if students are doing a survey of land forms, then having students identify land forms using slides or photographs beforehand will reinforce their knowledge of those land forms, as well as build their confidence in their observation skills. Similarly, if students will be doing an architectural survey, use slides and photographs not only to familiarize students with architectural styles but to engage students in recognizing the distinguishing characteristics they can expect to see in the field. Very young students may need to practice basic skills, such as following a route from instructions or even just identifying left, right, over, and under. Students can also practice sketching, map interpretation, and similar skills before heading into the field.

Require instrument briefings not only to familiarize students with how to use equipment but to ensure that they handle the equipment safely. For example, students doing a microclimate survey are likely to use compass and thermometers (air and soil). Before heading to the school yard or local park, students can learn how to use the compass and how to place soil thermometers without destroying the sensing tip. Students can also learn how to work cooperatively to collect data, as one student gives the instrument reading and another records it. It is also useful to practice recording skills, since incomplete data, or illegible data, will not be useful when the students return to the classroom.

Be prepared to brief students again in the field, especially if you plan a variety of activities or particular safety issues arise. Students get enthusiastic, excited, and distracted in the field, especially if it is a new environment for them, so continual briefings may be required to focus their attention.

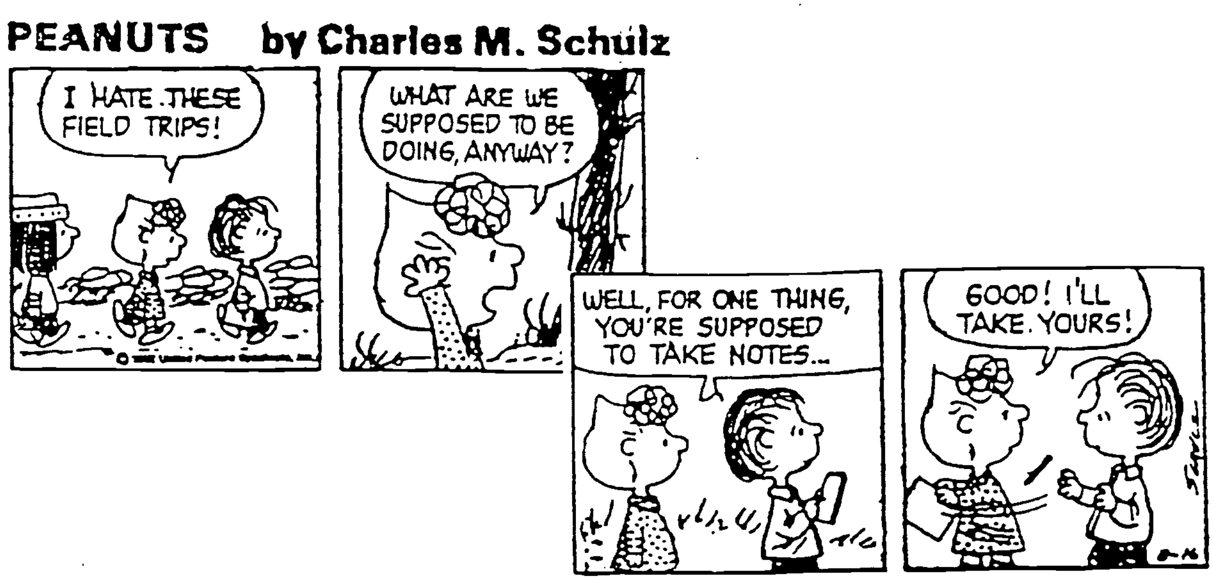
Data Collection

Once you brief and orient the students the class is ready to head into the field. Data collection is a skill that requires practice and tools. The practice comes in the field, from observation, recording and sample collection. The tools are data sheets, field logs, and field equipment.

Much of data collection is observation. Observation skills involve students sensing, and then describing, what they see, hear, smell, touch or taste. Encourage students to be curious (ask questions), look carefully (keep a sharp eye or nose), keep an open mind (trust your own senses), take notes (using words, figures or maps), note distinctions among features, and make comparisons.

Data collection may also include measuring what students observe and collecting samples. Measuring can include not just areal measurements, but counts and timings. Collect samples in the field for later analysis and interpretation in the classroom. It is important to discuss proper sample collection and ethics with students before going into the field. Establish clear procedures for sample collection; students should not, in their abundant enthusiasm, collect large numbers of samples that they will only throw away in the field or upon returning to the classroom.

Field Logs and Data Sheets: Students should record in field logs and on data sheets what they observe and measure in the field (see examples in Fieldwork Activities 5, 6, 7, and 9). The purpose of field logs is to record field experiences and observations, to serve as an aid to memory, to record changes over time (hourly, daily, seasonal, annual), and to record experiments, photos, and miscellaneous materials. The journals of Lewis and Clark are an excellent historical example of field logs.



Field logs consist of three basic components: field preparation materials, including maps, directions, statement of objectives, and the like; data sheets and road logs; and journal notes and sketches. Field logs vary in style and complexity, with the experience and knowledge level of the student as well as with the complexity of the project. At a minimum, a field log should contain:

- Date, time and place of observations
- Purpose of observations
- Details of observations and data collection
- Sketches where appropriate

The art of taking field notes consists of writing legibly, sketching where appropriate (no matter how bad an artist you are), annotating clearly, and stating the obvious. Too often the notes hastily scribbled in the field are illegible back in the classroom. The general guidelines to students in keeping usable field logs are:

- Write legibly.
- Record observations immediately (no matter how difficult the writing circumstances are). Details are easily forgotten.

- Write down as much as possible; do not hesitate to write down the obvious, and be as precise as possible.
- Use sketches and maps where appropriate.

Students can rewrite field logs after the fieldwork is over (see sample in Fieldwork Activity # 4). This can give students an opportunity to augment their observations, make conclusions, or simply clean up a messy sheet. Data collection in the rain or other inclement weather can be a trial. An expensive solution is to use weatherproof paper and pens. An inexpensive alternative is to cover each clipboard with an oversized piece of clear cellophane, large enough for a student to drape the cellophane over the writing arm.

Design data sheets for recording the specific data you might expect to gather from the fieldwork. The design of the data sheet should take into account the writing experience of the students and the organizational abilities of the students. Young students will need larger spaces for taking notes and sketching their observations; mature students may want to participate in the design of the data sheets. As a general rule, make sure the data sheet provides lines for name, date, and place, leaves plenty of space for students to write, and has clearly labeled columns and rows (where those are utilized).

Student field logs can have a long life. Teachers can keep student field logs for longitudinal studies of land use changes over time near the school, or of flood events in nearly streams. Students can look at field logs prepared by students ten years before, and use those field logs as part of the document research for the current fieldwork.

Field Equipment: Fieldwork can measure a range of parameters, such as traffic patterns, building types, soil and water pH, micro-climate, vegetation, topography, and land use. Some fieldwork requires very little equipment, but at a minimum students will need something on which to write and something with which to write. Clipboards and pencils, along with appropriate data sheets, will often suffice (though even clipboards can be dispensed with if the students have sturdy enough paper pads).

The essence of equipment planning is to make sure that you have the right equipment (will it measure what you intend it to measure?), enough equipment (how many students can you have in a group and still give every student an opportunity to actually use the equipment?), and working equipment (check all functions and batteries before you go into the field). Field equipment can be costly to buy, operate and maintain. For example, simple pyrometers to measure solar radiation can cost thousands of dollars; batteries for all sorts of field instruments are not cheap. Usually a choice of field equipment for specific field activities may have inexpensive substitutes available for elaborate professional-grade equipment (e.g., to measure humidity, students can use classroom-made sling psychrometers costing only a few dollars instead of battery-operated hygrometers costing tens of dollars).

Some fieldwork requires more sophisticated equipment for measuring, recording, or collecting samples. In-class training on the use of the equipment will be necessary and beneficial. Give students the opportunity to become proficient before they take the instruments into the field and it will not only save time in the field but will increase their confidence. Some instruments can be difficult for students, especially young students, to operate. Even holding an instrument steady can challenge some students (e.g., holding a compass steady or level for more than a few seconds may require some practice). Choose equipment that students can understand how to use and to physically operate.

In selecting instruments, consider the units of measurement you will need: what units of measurement are available in the instruments, what units of measurement are preferred in the curriculum, and what units can be used consistently among the various instruments. For example, it will likely confuse students if the soil thermometers are in Celsius and the air thermometers are in Fahrenheit, or the tape measure is in meters but students have not yet learned metric units.

Instruments should be durable: they will be subject to all sorts of abuse not only in the field but in traveling to and from the field. For example, glass thermometers and psychrometers are somewhat cheaper than hygrometers (that measure temperature and relative humidity), but hygrometers have no easily breakable glass components and last longer. Fiberglass measuring tapes tend to outlast their cloth counterparts (that tear and rot) and their metal counterparts (that rust and bend). Reel-in tapes seem convenient, but are much harder to keep clean than open-faced tapes. Although it may cost more initially, try to invest in well-made, durable field equipment that is easy to maintain and use.

Teachers should brief students on equipment safety, use and care. Students should learn habits of good field equipment care: using it properly and carefully, keeping it clean (or cleaning it thoroughly after use) and making sure to save the batteries by turning off all field equipment when it is not in use.

Numerous equipment catalogues are available on the Internet and through school districts. Sometimes the least expensive equipment can be found through professional supply stores. For example, companies that supply equipment to public and private foresters often have inexpensive tape measures, thermometers and compasses, as well as educational discounts. Always ask for an educator discount even when buying supplies from local grocery stores. Parents (or the companies they work for) can often be good sources of new or used equipment.

Data Analysis and Presentation of Fieldwork

When students have completed the data collection, and are back in the classroom, it is important to allocate time for them to discuss and present their findings. The basic follow-up to fieldwork consists of: organization of raw data; group discussions of findings (to develop a consensus within the group before presenting results); class discussion of findings and comparisons among groups; presentation of findings. These activities provide students with the opportunity to analyze what they have discovered and to design an effective way to present their discoveries.

Organization of raw data: Once back in the classroom, students need to review their journals and data sheets to organize the data they have collected. This requires some preliminary decisions about how they will present the data (what graphics, tables, figures they will use), that in turn will depend on whether the presentation is oral, written, or both. Numerical data is often first organized in tabular form, with rough graphics helping students to visualize their findings. A wide range of tabular, graphic, and cartographic techniques are available to students; allowing them to explore and select from the many options helps build student confidence in the use of different and sometimes more sophisticated techniques (Richardson and St. John 1989).

Analysis: Kent *et al.* (1997) have suggested the use of extended debriefings designed to guide students through the analysis component of fieldwork while integrating the field experience with the learning objectives in the classroom. To this end, debriefings should:

- Encourage a thorough integration of the geographic concept with the field experience, including making sure students see how the fieldwork connects to the curriculum they have been studying.
- Be conducted promptly while the experience is still fresh and students can share- and-compare observations.
- Allow comparison with documents (archival materials) and other sites, where appropriate.

It is equally critical to allow sufficient time for analysis since this is when students can grapple with the geographical concept that prompted the fieldwork and relate it to their experience in the field. Lonergan and Anderson (1988) have observed that fieldwork is complex and time-limited, resulting in insufficient time in the field for students to do analysis. As the students begin to grapple with data organization and analysis, they should be able to make connections to the curriculum. A fundamental goal is that students see how the fieldwork connects to concepts previously presented in class.

In analyzing their fieldwork students need to review the data sheets, field logs, maps, sketches, photos and field observations and findings. From this, students can draw preliminary conclusions related to the geographic question posed at the outset of the fieldwork. Where possible, students can compare their conclusions with previously researched archival data (or last year's students' findings if such longitudinal studies using the same field site are available). Students can then arrive at conclusions and pose new questions and new hypotheses for future examination.

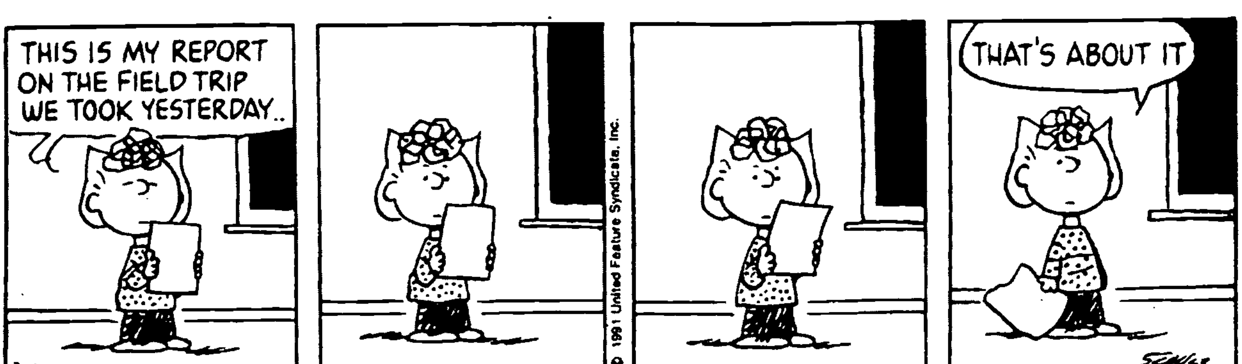
Presentation of Fieldwork: Presentation of field data and conclusions is as important as the collection of field data. Presentation allows the students to demonstrate what they did and what they learned in the data collection and analysis. Presentations of results can take a wide variety of forms, and should be integrated into the larger curricular framework. For example, if oral communication skills are stressed in the classroom, then oral presentation of field findings should be part of the presentation format. Similarly, if the geography and art teachers have the opportunity to collaborate, then an artistic rendering, via model or sketch, could be incorporated in the findings.

4. Analyzing and organizing data in the field.
Markham Elementary School,
Oregon field project.

For upper grades, fieldwork presentation also provides an opportunity to enhance students' data processing skills (spreadsheet use, graphic design, and word processing). For younger students it provides an opportunity for them to see that an idea can be presented or described in a variety of formats. For example, elementary students can learn and apply simple mathematics concepts such as graphing using field data. Students can use their imagination and individual talents in presenting fieldwork, A student with an artistic bent might display detailed and technically exquisite field sketches or maps. A student with a mathematical frame of mind might generate data table and graphs. The technologically oriented student or group might put it all together in a *virtual* presentation or multi-media display.

Regardless of the particular fieldwork or data collected, there are fundamental and wide-ranging techniques of data presentation. The techniques can be divided into four broad categories:

- Text, such as written descriptions, summaries, conclusions
- Pictures, such as field sketches, photos, or other images
- Maps, such as sketched maps, base maps, or archival maps
- Graphs, such as pie charts, flow diagrams, or data table.



Which presentation technique the student selects will be in part functions of the fieldwork objective. The particular data collection may lend itself to a specific form of presentation, or the teacher might want the student to work on a particular skill or technique or for a group of students to present a range of skills or techniques. The student competence level also governs presentation. Obviously, most first graders are unlikely to create correlation scattergraphs, but even young geographers can create pictorial bar graphs. The greater the student knowledge and skill level, the wider the range of presentation options. The more sophisticated the student, the more the student can actively select the appropriate data display technique.

Text is often used to describe the purpose and scope of the fieldwork, a summary of the activities, and the conclusions reached. The text of the purpose and scope of the fieldwork can (and should!) be drafted before the fieldwork begins, as part of the preparation process. Students should be able to derive the text of the summary as well as conclusions from the consensus built by the students during the debriefing and analysis as they compare notes on their individual observations.

A fundamental form of fieldwork presentation is field sketching, drawings made in the field that show some feature of interest, from a land form to a building, to a plant or flower. Field sketching encourages the student to make close and accurate observations, and to focus on what is important for purposes of the field activity. Unlike photographs, field sketches can delete or add critical details, or emphasize particular aspects of the feature. Make certain students label all field sketches accurately according to time, date, and place, and should include notes about key features.

Use maps (including base maps, profiles and cross-sections) to give location information or present findings. Also use archival maps for comparison with current site characteristics; map overlays can highlight changes over time.

Data tables and charts are a concise way of presenting data collected in the field. The data are divided into appropriate rows and columns with complete labeling. As a general rule, the table should have a concise title and clearly identified units of measurement.

Graphs, like data tables, are of many different types and can be used to present raw or manipulated data. The type of graph used is largely dependent on the type of data and skill and knowledge level of the student. Richardson and St. John (1989) have described generalized data display techniques for particular types of information gathered. Table 3.1 presents an adaptation of their techniques list adopted for elementary and secondary fieldwork; Figures 3.1-3.20 are examples of the display techniques.

Photographs can provide striking visual images of the field site, detail impressions of the materials being studied, or amusing shots of the students in action in the field. Whatever their function, the photographs should be clearly labeled (title, date, and names of persons in the photo). Video displays can enliven fieldwork presentations and can provide an historic record of site and methodology.

Surveys are frequently a part of fieldwork, such as students' analysis of shopping patterns or recreation use analysis. If you are using surveys in fieldwork, a copy of the questionnaire and a description of the survey sample should be an element in the fieldwork presentation.

A Note on Information technology and fieldwork: You should attempt to use information technology to support local fieldwork, particularly as part of briefing materials (Warburton and Higgitt 1997; Bellan and Schleurman 1998). From site-specific information to academic background on a topic or issue, information technology can provide not only archival material but can elicit some surprising research questions. For example, high school students in Portland, Oregon, were doing archival research on a local stream and discovered via the Internet that theirs was virtually the only stream in that region of the city. They wondered why and, through web-based research and a field visit to the regional mapping agency, discovered that nearly all the pre-urbanization streams had disappeared. This in turn led to fieldwork on rediscovering the paths of the buried and culvertized stream systems.

Table 3.1: Data Display Techniques

Type of Information or Data Collected	Display Techniques	Figure Number
Introducing a subject matter or area	Base maps	3.1
	Data tables	3.2
	Field sketches	3.3
	Maps	3.4
Organizing raw data for analysis and display	Data tables	3.2
Representing sequential data that change over time	Line charts	3.5
	Line graphs	3.6
	Pictograms	3.7
Representing data at specific locations and with definable categories	Bar graphs	3.8
	Histograms	3.9
	Pie charts	3.10
Representing connections between two sets of data	Scattergraphs	3.11
Representing data that show a specific orientation	Rose diagrams	3.12
Data composed of a number of elements that total 100%	Triangular graphs (three data items)	3.13
	Bar graphs	3.7
Representing measurements of side views	Profiles/transects	3.14a & b
	Cross sections	3.15
Representing data collected either continuously or at intervals along a transect	Scattergraphs	3.11
	Profiles and cross-sections	3.14; 3.15
	Divided bars	3.16
Representing data showing spatial variation at a given time using underlying base maps	Dot maps	3.17
	Symbols/proportional symbols	3.18
	Isopleths	3.19
Representing data that show spatial variation of movement and flows	Composite bar graphs	3.20
	Flow lines	3.21

Modified from Richardson and St. John (1989)

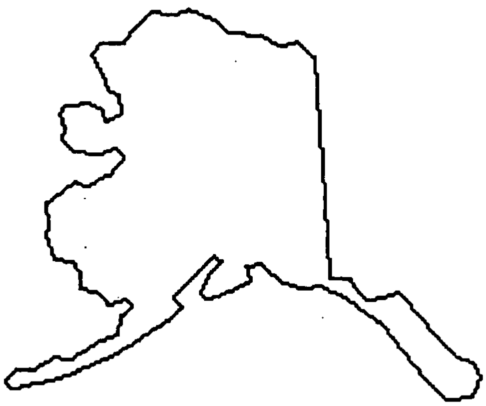
Using information technology in the field through equipment such as Global Positioning Systems can provide ground truth information. Using geographic information systems can also assist in data analysis and presentation upon completion of the data gathering portion of the fieldwork. Internet sites can provide maps, photos, and other archival material for use in preparing and presenting fieldwork.

Increasingly, virtual fieldwork, using information technology, is being promoted as a less expensive alternative to actual fieldwork. Field trip simulations, used in in-class learning stations (Gress and Scott 1996; Crampton 1998) can inform students about exotic or distant places, but cannot replace the pedagogic benefits of on-site fieldwork. Exploration of distant places is different from fieldwork.

Information technology, from digital video displays to computerized geographic information systems, to interactive computer presentations, provides exciting opportunities for visual displays of fieldwork. The fundamentals remain the same such as data collection in the field followed by analysis. In many cases, a hand-drawn field map may be as effective a display technique as a multicolored, laser-printed, publication-ready map. Where the curriculum encourages the use of information technologies, or where particular students have greater levels of engagement when using such technologies, fieldwork presentation provides an ideal opportunity for challenging students to translate what they have sensed and measured into displays accessible to any viewer.

Figures 3.1-3.20: Data Display Techniques

Fig. 3.1. Base Map



Alaska

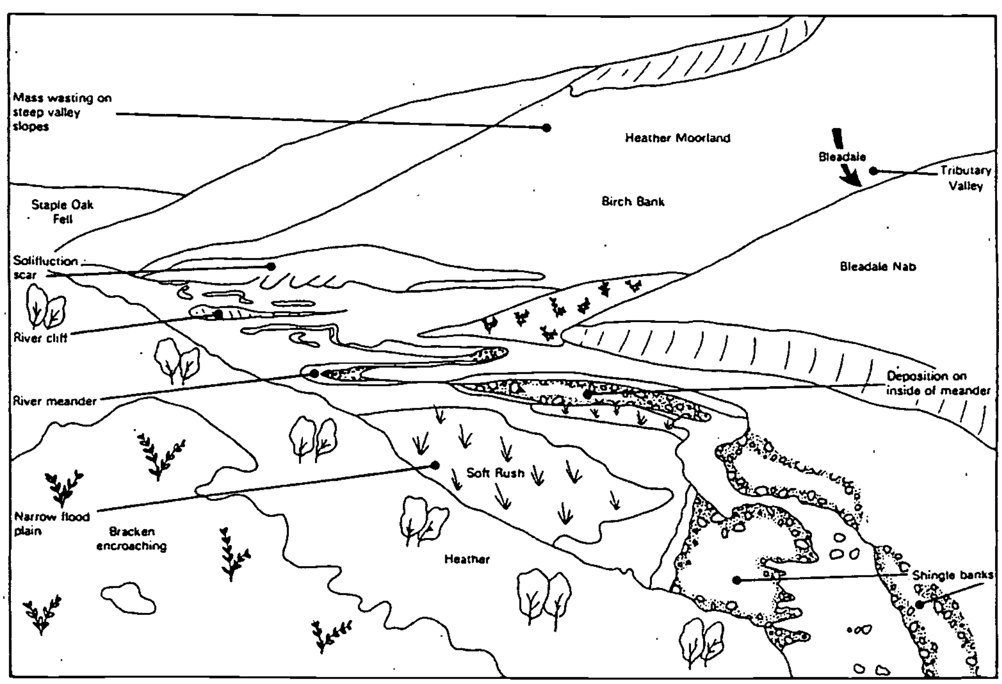
Fig. 3.2. Data Table

Number of vehicles on Marsh Street

Time:	8-9am	9-10am	10-11am	11-12 noon
Cars	74	42	45	65
Small Trucks	12	17	21	5
Big Trucks	8	9	13	11
Motorcycles	0	1	2	0
Police cars	2	1	0	1
Other	4	2	3	1

Fig. 3.3. Field Sketch

Field sketch of Langden Brook looking downstream from G.R. 603504 showing the main valley features.



Source: Jay 1987

Fig. 3.4. Maps

Origin and Diffusion of the Betel Nut Palm

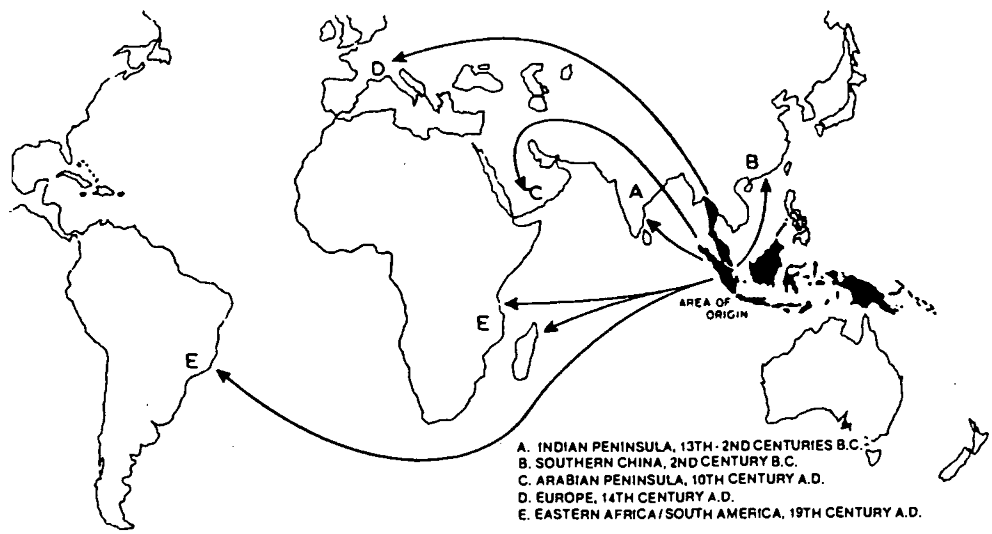


Fig. 3.5 Line Chart

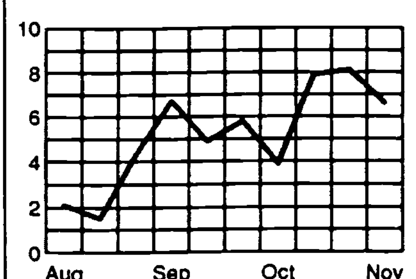
pH Ranges of Aquatic Life

Most acidic — Neutral — Most alkaline

1 2 3 4 5 6 7 8 9 10 11 12 13 14

"Rough" fish: carp, catfish	6 — 9
Algae and other plants	6.5 — 12
Bass	6.5 — 8.5
Snails, tadpoles, clams	7 — 9
Trout, most flies, salmonids	6.5 — 7.5

Fig. 3.6. Line Graph



Bushels of apples harvested on the Marks Farm per day

Fig. 3.7. Pictogram

Number of cars on Marsh Street (April 4, 1990)

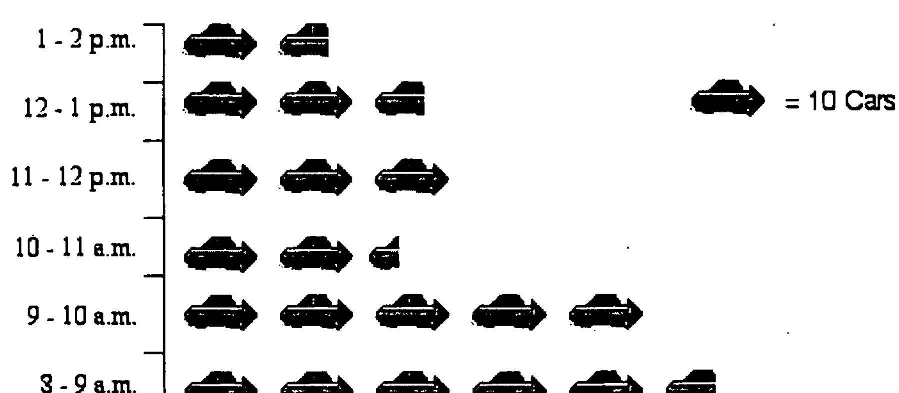


Fig. 3.8. Bar Graph

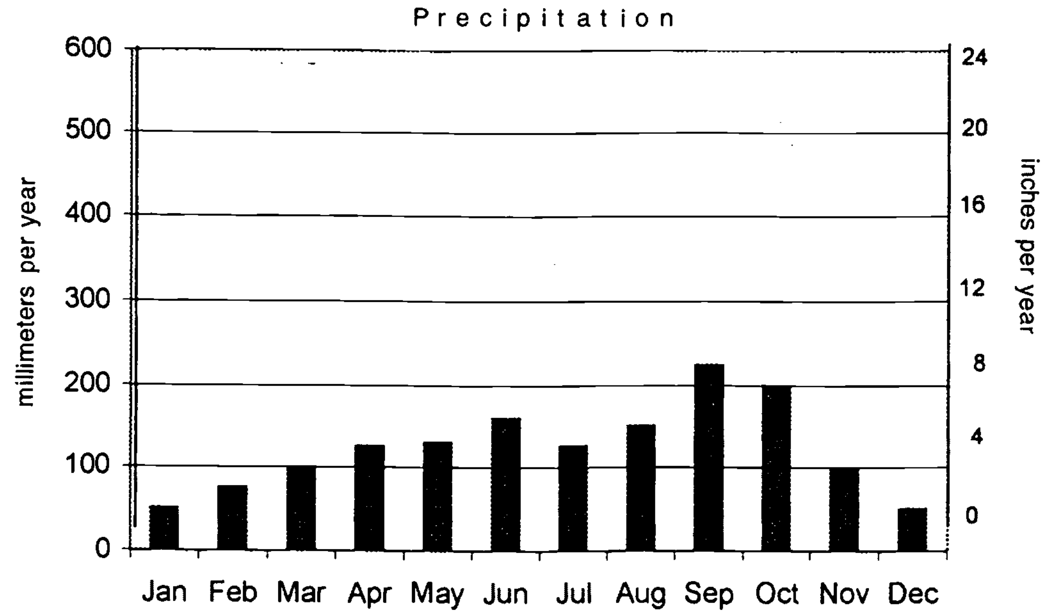
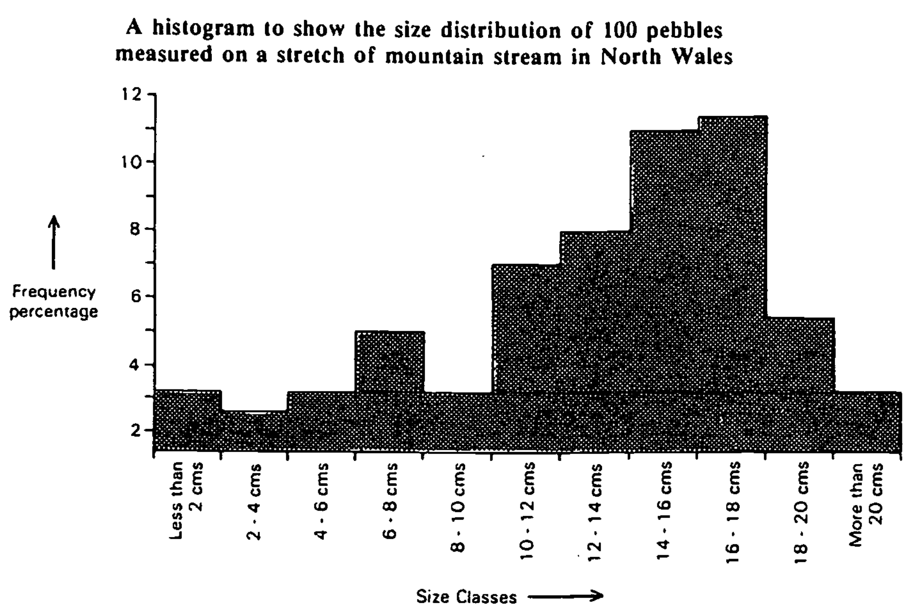


Fig. 3.9. Histogram



(Source: Jay 1987)

Fig. 3.10. Pie Chart

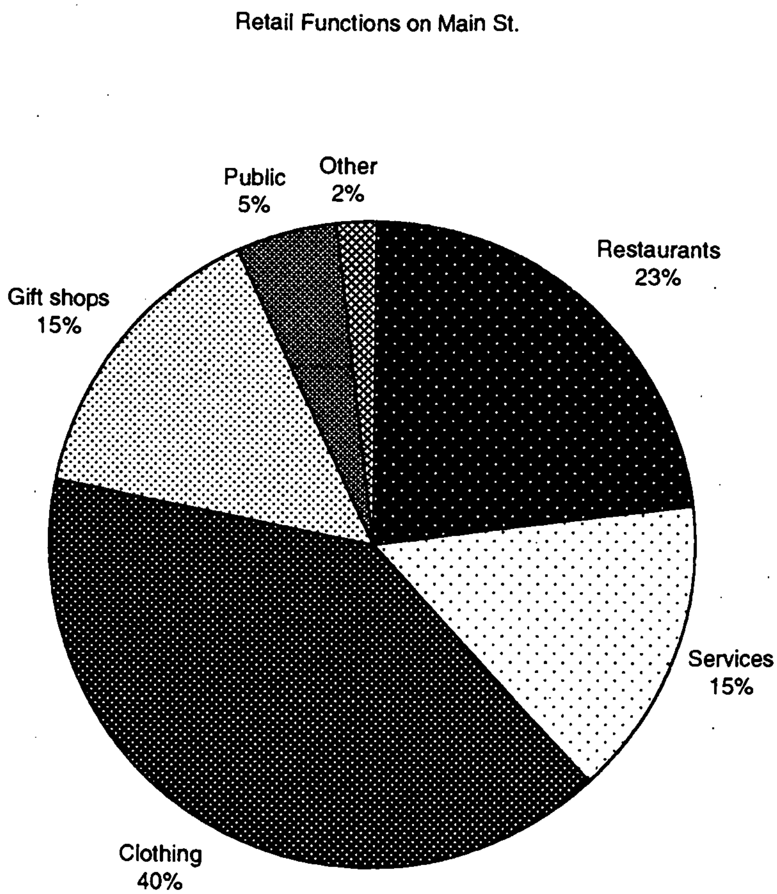


Fig. 3.11. Scattergraph

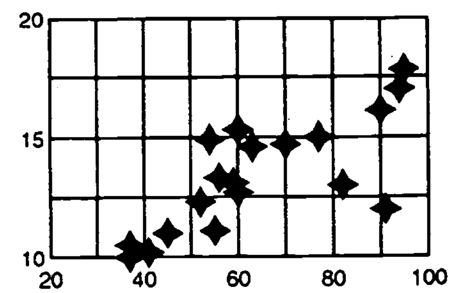
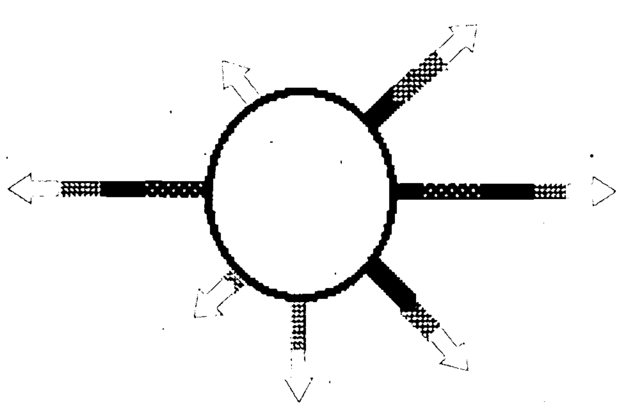


Fig. 3.12. Rose Diagram



Wind direction and strengths observed at PDX for 1999

% frequencies

0 10 20

Fig. 3.13. Triangular Graph

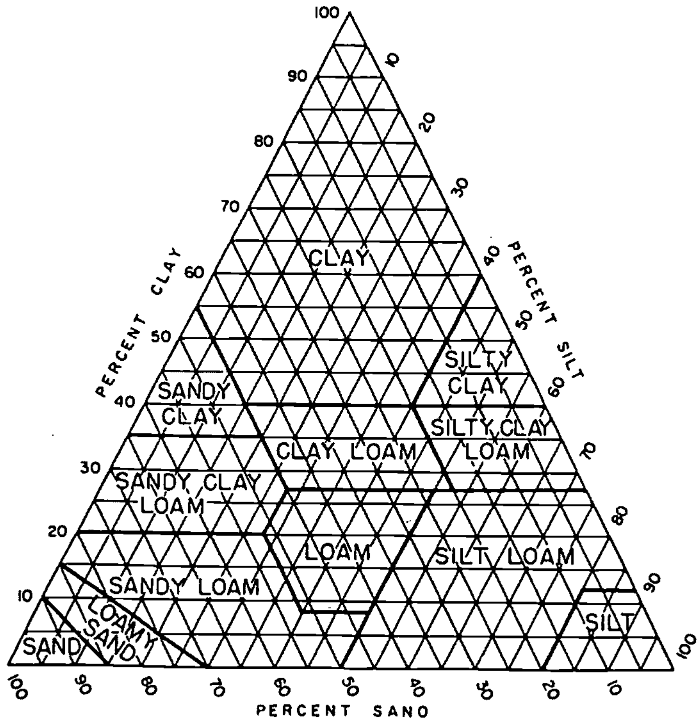
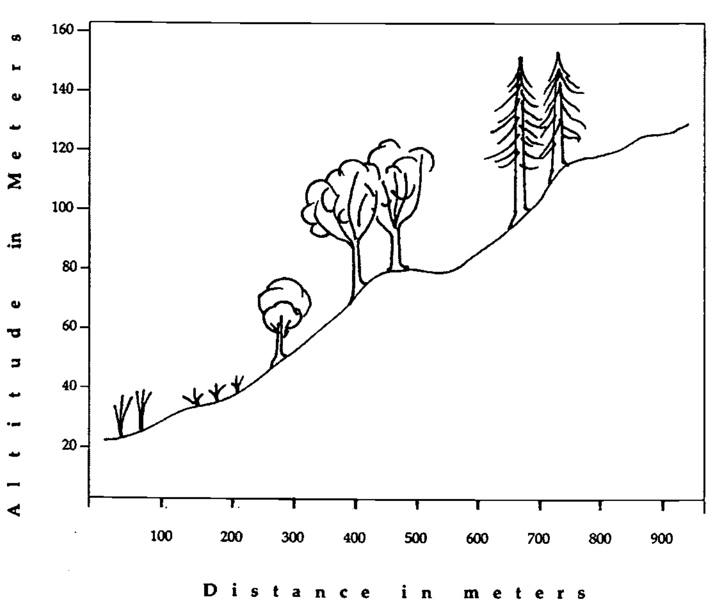


Fig. 3.14a. Transect



Vegetation Transect: Vertical Zonation

Fig. 3.14b. Profile

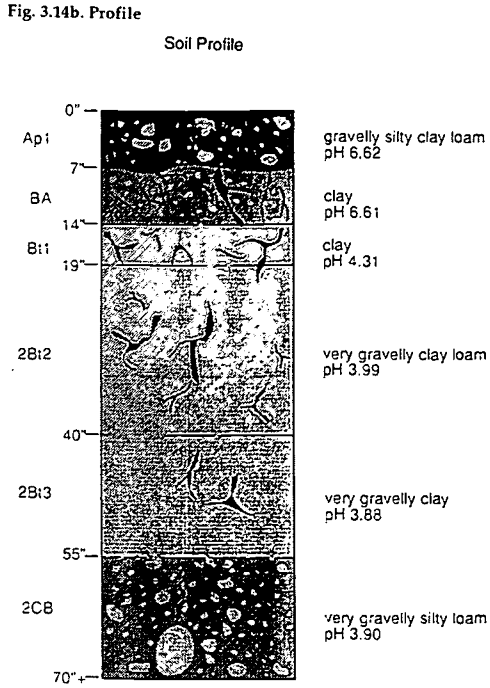


Fig. 3.15. Cross Section

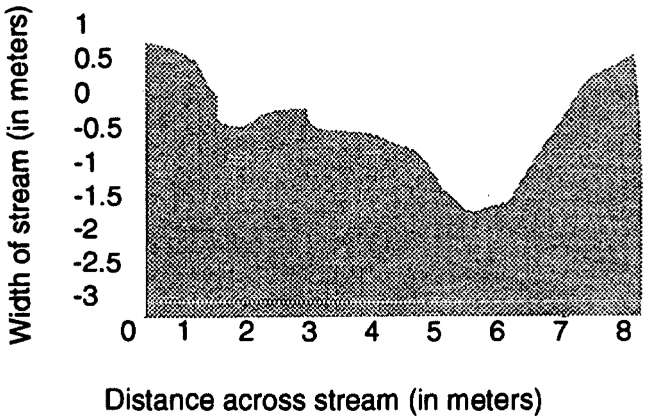


Fig. 3.16. Divided Bars

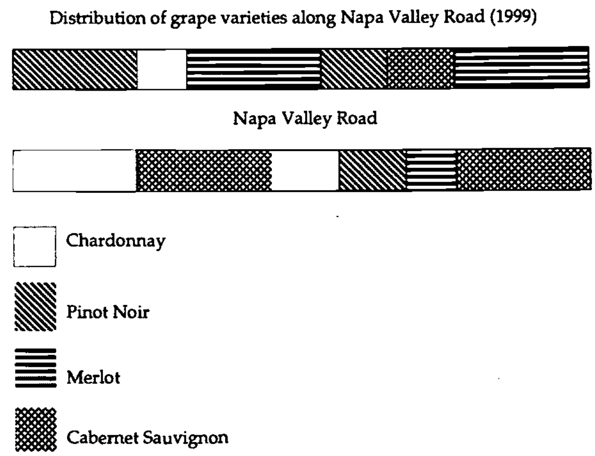
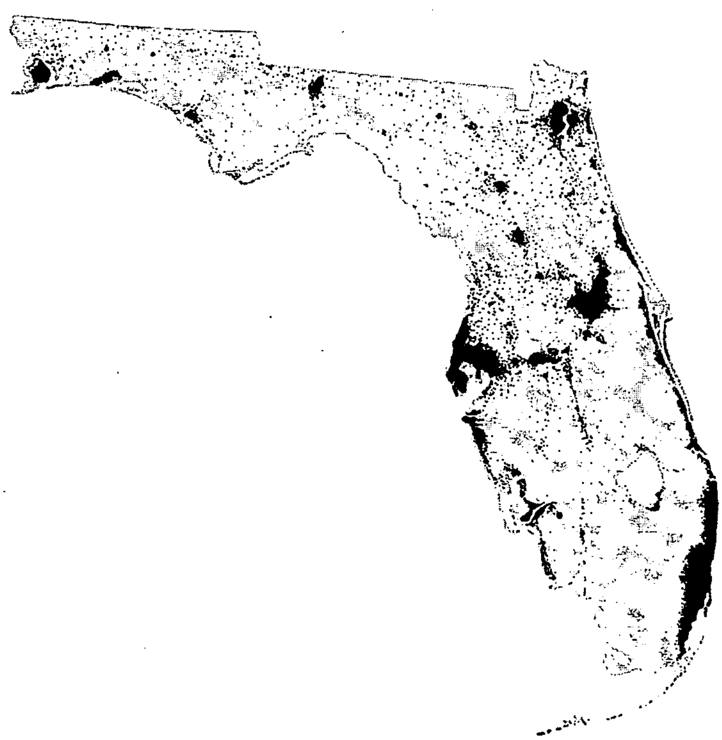


Fig. 3.17. Dot Map

Population Distribution



One dot represents 1,000 Persons

Source: Oldakowski, R., L. Molina, and B. Purdum 1997. *Growth, Technology, Planning, and Geographic Education in Central Florida: Images and Encounters*. Indiana, Pa.: National Council for Geographic Education, 39.

Fig. 3.18. Symbols / Proportional Symbols

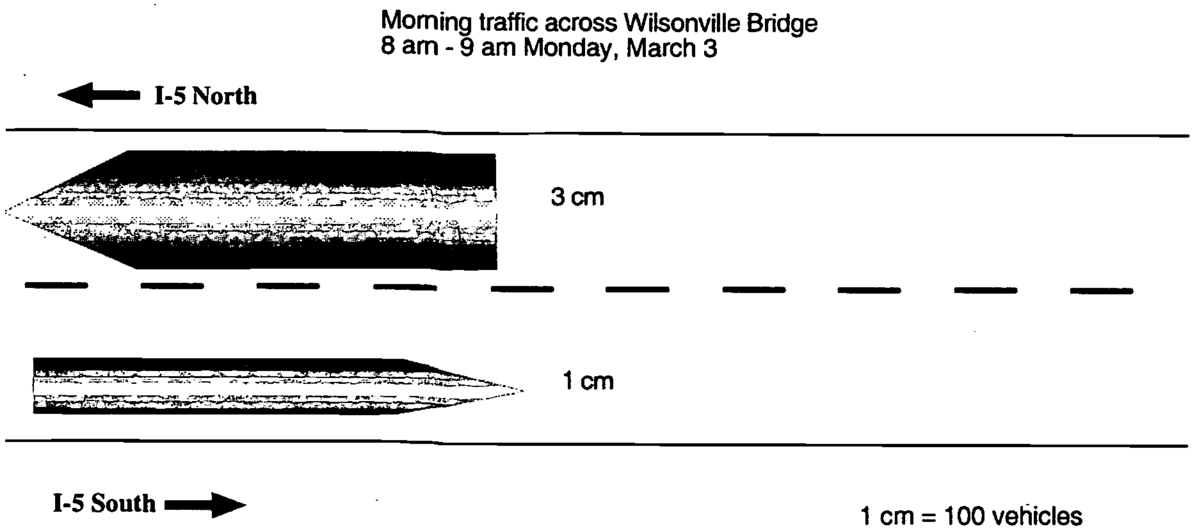
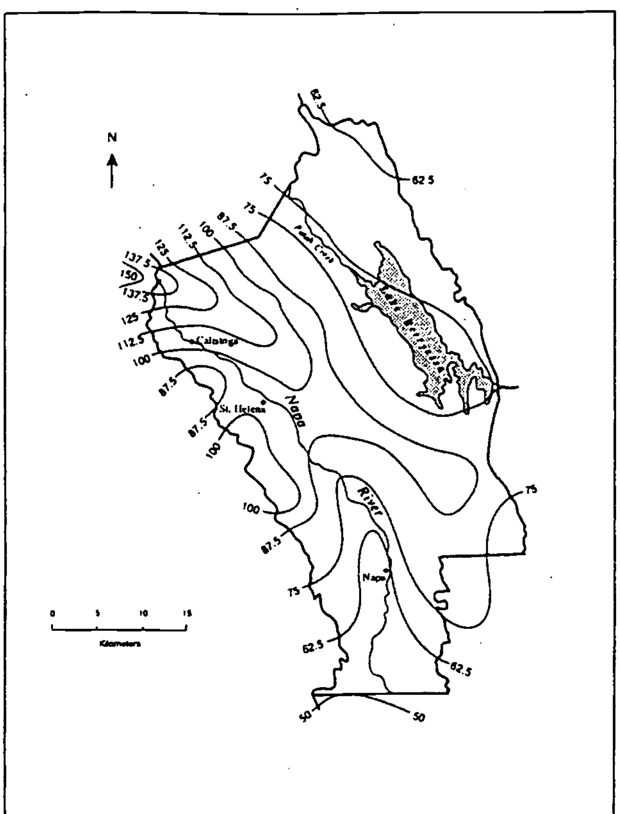


Fig. 3.19. Isopleth Map



Mean annual precipitation in Napa County, California

Fig. 3.20. Composite Bar Graph

Assessment of Fieldwork

Assessment of fieldwork involves evaluation of the preparation, implementation, analysis, and presentation of the fieldwork. Assessment serves not only to provide formal feedback to the student but also to integrate the field experience with the curriculum.

Positive attitudes and perceptions are crucial if students are to learn proficiently. In fact, teachers must devote considerable time toward developing students' beliefs, attitudes, and values. Yet, for a variety of reasons, teachers tend to ignore the affective realm when articulating objectives or outcomes and when designing ways to assess them. Richard Stiggins (1994: 327) has pointed out that, "affect is every bit as important to student well-being as are knowledge, thinking, skills, and product outcomes." Marzano (1992: 125) echoes this view:

> Although acquiring content knowledge is important, it is not perhaps the most important goal of education. Ultimately, developing mental habits that will enable individuals to learn on their own whatever they want or need to know at any point in their lives is probably the most important goal of education.

The level of fieldwork in which the students have been engaged—observation, investigation, inquiry—will govern the assessment criteria and process to a large degree. It is possible to assess a variety of geographic content, geographic skills, social skills and technology skills, depending on the structure and requirements of the fieldwork and presentation. Teachers must also assess the quality of presentation and presentation skills. For example, if you require oral presentations, then you must incorporate assessment of a student's public speaking skills in the overall assessment of the fieldwork as well as evaluating information technology skills—the ability of students to enter and manipulate data in software programs, and use appropriate display techniques for the results.

Often fieldwork involves group work. This provides an opportunity for the teacher to assess organizational, leadership, and participation skills, but it also provides an opportunity for students to assess each other and to think critically about their own fieldwork and presentations. Use peer assessment, particularly at the upper grade levels, not only to engage students in the assessment process and to develop assessment skills but to alleviate some of the concerns students often have with regard to assessment of group activity. Assessment of group activity, where students share marks, also provides a practical real world work experience.

The entire class can evaluate student oral reports and give students the opportunity to engage in the evaluation of content and quality of oral presentations, which will no doubt cause them to think about the content and nature of their own oral presentation. Peer assessment is usually anonymous, and can be used at several stages in the process, such as after students complete first drafts of field reports. Students then have an opportunity to revise field reports based on peer review. We provide below a series of scoring guides for assessment of a range of fieldwork skills in both the cognitive and the affective realms,

Scoring Guide #1: Self Evaluation: Student Checklists for Revision

Self-evaluation and monitoring progress are important stages in fieldwork if students are to become autonomous learners. One method of self-evaluation is to have students use checklists to evaluate their work and to make revisions prior to turning in the final product or making presentations. Below are some examples of checklists that teachers can use for fieldwork.

Checklist for Written or Oral Presentation of Fieldwork

Teachers can adapt this list for either an oral presentation or a written one.

Instructions: Use this checklist to evaluate your work before you make your final presentation. To get the highest score you will want to check each of the following.

- My presentation has a clear purpose and I can clearly state the geographic question(s) investigated.
- I can describe how:
  I made observations and collected data;
  I organized the data; and
  I analyzed the data to answer the geographic question(s).
- My field logs and data sheets are complete, detailed, and accurate.
- I have created maps, graphs, sketches or other visuals to organize my results.
- Maps, graphs, and other visuals are accurate, neat, and have titles or labels.
- I have used the maps, charts, and other visuals to analyze my results.
- I have supported my conclusions with specific information from my fieldwork including the visuals.
- I have organized my presentation with an introduction, middle, and conclusion.

Student Checklists for Maps, Graphs, and Other Visuals

Maps:

- My map has a clear title that explains its purpose.
- I have included a key or legend in which I explain all symbols.
- My map is neatly drawn, detailed, labeled, and easy to read.
- I have included a scale.
- My map is oriented properly towards North with a *North* sign or compass rose.

Graphs:

- I chose the best type of graph to use to display my data.
- My graph has a clear title which explains its purpose.
- I have placed the data I collected on the graph accurately using the correct axis.
- I have labeled each axis correctly.
- I chose a scale for each axis that uses the space well and is appropriate for the data.
- I used color and shading to make the graphs easy to read.
- I included a key to my graph.
- My graph was neat and easy to read.

Charts, Diagrams, and Sketches:

- I have included a title that clearly explains its purpose.
- I have clearly labeled my chart, diagram, or sketch.
- My chart, diagram, or sketch is neat and easy to read.

Scoring Guide #2:
Attitude, Conduct, Collaboration, and Leadership: A Numerical Rating Scale

Directions: Indicate how often the student demonstrates each of these behaviors while engaged in fieldwork in the field and in the classroom. For each behavior:

Circle 4 if the student **consistently** demonstrates that behavior.
Circle 3 if the student **usually** demonstrates that behavior.
Circle 2 if the student **seldom** demonstrates that behavior.
Circle 1 if the student **rarely** demonstrates that behavior.

Conduct and Attitude
4 3 2 1 A Demonstrates respect and enthusiasm for the purpose of the fieldwork.
4 3 2 1 B Demonstrates a willingness to ask questions and to identify and solve problems.
4 3 2 1 C Effectively contributes to deepen and broaden the discussion of the fieldwork process.
4 3 2 1 D Demonstrates a capacity for autonomous learning (is self-directed).
4 3 2 1 E Demonstrates a respect for the environment in which the fieldwork takes place.
4 3 2 1 F Demonstrates an awareness of and appreciation for safety in the field.

Collaboration
4 3 2 1 A Works to help achieve the goals of the group.
4 3 2 1 B Communicates well with other group members.
4 3 2 1 C Helps to make sure that the group works well together.
4 3 2 1 D Performs a variety of tasks in the group.

Leadership
4 3 2 1 A Takes clear responsibility for the group's performance.
4 3 2 1 B Is willing to monitor roles and responsibilities within the group.
4 3 2 1 C Takes stock of the overall direction of the fieldwork and effectiveness of the process, and takes opportunities to redirect group as necessary.
4 3 2 1 D Offers appropriate feedback and effective guidance to other group members.
4 3 2 1 E Takes steps to involve reticent participants and insure that they address unnoticed points.

Scoring Guide #3:
Written Presentation (Middle and High School)

1

Exemplary: Exceptional writing and use of graphics. Distinctive use of tables and figures. Sophisticated use of concepts and problem-solving approaches. Demonstrates strong understanding of geographic concepts and the use of fieldwork to demonstrate concepts

2

Strong: Text and graphics are clearly linked. Few mistakes in content. Good demonstration of skills. Clear links with geographic concepts

3

Proficient: Text and use of graphics meet the standard. Demonstrates basic mastery of skills. Reflects an understanding of key concepts and links with fieldwork and data. Presentation has more strengths than weaknesses.

4

Emerging: Text and graphics are incomplete and superficial. Links between ideas are unclear. Some mastery of content and skills but major gaps or mistakes are apparent.

5

Beginning: Texts and graphics are minimal. Shows lack of understanding of key concepts and skills. Writing and use of graphics contain major errors. The fieldwork and data are not linked to key geographic concepts.

Scoring Guide #4: Oral Presentation of Fieldwork Results: A Holistic Scoring Guide

5 Excellent: The student
- describes clearly the fieldwork question(s) and procedures for collecting, organizing, and analyzing the fieldwork data.
- gives specific information from the fieldwork results to support the conclusions drawn and described.
- presents maps, graphs, sketches, and other supporting visuals that are accurate, clear, neat, appropriate for the data, and labeled.
- uses visuals to make the presentation more effective.
- delivers an engaging report that contains consistently correct sentence structure. Eye contact is made throughout most of the presentation.
- provides fieldwork topic shows strong evidence of preparation, organization, and enthusiasm for the fieldwork topic.
- answers questions from the audience clearly with specific and appropriate information.

4 Very Good: The student
- describes the fieldwork question(s) investigated and procedures for collecting, organizing, and analyzing the fieldwork data.
- provides an adequate amount of information to support the conclusions that are drawn and described.
- uses maps, graphs, and other visuals that are appropriate for the data, neat, and labeled.
- mentions the visuals in the presentation.
- delivers a presentation in which sentence structures are generally correct.
- shows evidence of enthusiasm, preparation, and organization for the fieldwork topic.
- answers questions from the audience clearly.

3 Good: The student
- describes the fieldwork question(s) and procedures for collecting, organizing, and analyzing the fieldwork data.
- states conclusions but supporting information is not as strong as a 4 or a 5.
- uses maps, graphs, and other visuals and mentions them in the presentation.
- delivers a presentation in which sentence structures are generally correct.
- shows some indication of preparation and organization.
- answers questions from the audience.

2 Limited: The student
- states the fieldwork question(s) investigated but fails to fully describe the procedures for collecting, organizing, and analyzing the fieldwork data.
- gives no conclusions to answer the fieldwork question(s).
- uses a map or graph that is not referred to in the presentation.
- delivers a presentation in which sentence structures are understandable but with some errors.
- lacks evidence of preparation and organization.
- answers questions from the audience with only the most basic responses.

1 Poor: The student
- makes the presentation without stating the fieldwork question(s) or describing the procedure for collecting, organizing, or analyzing the fieldwork data.
- answers the fieldwork question unclearly and states no adequate conclusions
- has no maps, chart, or other visuals.
- presents a delivery that is difficult to follow.
- evidences no indication of preparation or organization.
- answers questions from the audience providing only the most basic, or no, response.

0 No attempt

Scoring Guide #5: Oral Presentation (High School)

Evaluation of Oral Presentation						
		Very Good	**Good**	**Average**	**Poor**	**Inadequate**
Quality of oral presentation	Clarity	5	4	3	2	1
	Audibility	5	4	3	2	1
	Enthusiasm	5	4	3	2	1
	Pace of delivery	5	4	3	2	1
Relevance and depth of information	Logical, coherent structure	10	8	6	4	2
	Use of relevant material	10	8	6	4	2
Quality of support materials used	Visual aids	5	4	3	2	1
	Stimulated questions	5	4	3	2	1
	Ability to respond to questions	5	4	3	2	1
Time management	Presented within allowed time	5	4	3	2	1
	Allocated enough time to each topic	5	4	3	2	1
	Subtotals					
	TOTAL					

Scoring Guide #6:
Oral Presentation (Middle and High School)

This may be used as a checklist for students as they prepare oral presentations, as a peer-review scoring guide, or as a teacher's scoring guide.

Element	**Above Average**	**Average**	**Needs Work**
Content:			
The ideas relate to the fieldwork and data analysis			
The presentation has a clear purpose and conclusion			
The presentation gives supporting details			
The presentation uses appropriate citations and resources			
Gears the presentation to the audience			
Language and graphics:			
Uses clear, accurate, and descriptive vocabulary			
Uses appropriate technical and non-technical language			
Uses correct grammar			
Draws graphics visibly and clearly			
Uses graphics appropriate for the discussion			
Organization and Delivery:			
Clear introduction, middle, and conclusion of presentation			
Clear order and good pacing of ideas			
Uses effective transitions from point to point			
Maintains eye contact and appropriate voice volume and pacing			
Speaks clearly and avoids pauses and "ums".			
Body language (expressions/gestures) augments effectiveness			

Scoring Guide #7: For Oral Presentation: Elementary Grades

I stood up straight and faced the audience	☺	😐	☹
I spoke clearly and loudly	☺	😐	☹
I maintained eye contact with the audience	☺	😐	☹
I varied my tone to emphasize points	☺	😐	☹
I changed facial expression and tone of voice	☺	😐	☹
I was well organized	☺	😐	☹
I didn't repeat myself	☺	😐	☹
I avoided saying "um" and making similar expressions	☺	😐	☹

Scoring Guide #8 Peer Review of Fieldwork Presentation

Your Name ______________________________

For each member of your group, including yourself, assess her or him on each of the criteria listed below

Be sure to provide justification for your response on the back of this form

For each criterion, rate each member of your group as follows:

Outstanding contribution	+2
Above average contribution	+1
Average contribution	0
Below average contribution	-1
Little or no contribution	-2

Please note that each row must sum to zero, and the students' totals must sum to zero

Assessment Criteria	Student Name	Student Name	Student Name	Student Name	Student Name	Student Name
Logistics: Did the student participate in fieldwork preparation and meet group deadlines?						
Leadership: Did the student provide leadership through listening to others and helping the group to function as a team?						
Group dynamics: Did the student share group responsibility without argument or disruption						
Intellectual contribution: Did the student provide useful ideas, helpful suggestions, and feedback to the group?						
Verbal presentation: Did the student help in presenting the fieldwork in accordance with group decisions?						
Research/writing/editing: Did the student write the field report in accordance with the group decisions?						
Total for each student						

4

Examples of Fieldwork

"Just do it!"
Nike

The following fieldwork activities are representative samples of a range of elementary and secondary geographic field projects. Teachers have field-tested each of these activities at a variety of professional geography meetings and in schools. The fieldwork described can be a starting point for teachers. Teachers can build upon, modify, or extend each of these activities. In several cases, we describe field-tested extensions.

The fieldwork in these activities is inexpensive; most involve little or no field equipment (other than clipboard and pencils), or require inexpensive materials. Teachers can carry on the fieldwork exercises, in most cases, at or near the school building. Although the land-use survey activities are most useful in urban settings, teachers can adapt them to more rural environments. The fieldwork exercises do not require complex planning or execution, both of which can inhibit teachers from experimenting with them.

Table 4.1 is a guide to the fieldwork examples, with designations of geographic topic, principal grade, setting (rural or urban), and national geography standard and AP topic addressed. The guide should not limit the adaptation of the exercises or their use in other grade levels or locations. An exercise in observation skills that teachers can adapt for all grade levels precedes the fieldwork activities.

Information on the National Geography Standards is available in *Geography for Life: National Geography Standards.* 1994. Washington, D.C.: National Geographic Research and Exploration for the American Geographical Society, Association of American Geographers, National Council for Geographic Education, and the National Geographic Society. (Available from the National Council for Geographic Education, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA 15705, $7.00 plus postage and handling.)

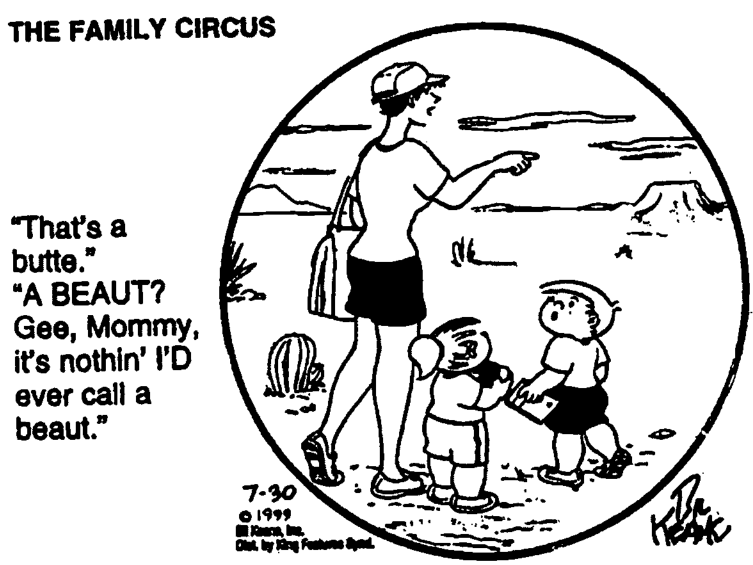


Table 4.1 Fieldwork Examples

#	Fieldwork	Grade Level	Observation/ Investigation/ Inquiry	Geographic Field	National Geography Standards and Advanced Placement
1	Basic observation skills	K-12	Observation	NA: in-class	NA
2	Rosie's Walk: An Observational Walk	Pre-School and Elementary	Observation	Rural or Urban	4
3	Mapping a trail or area	Upper Elementary to High School	Investigation	Rural or Urban	1
4	Landscape Observation	Elementary+	Observation	Rural or Urban	3, 8, 12
5	Micro-climates: indoors and outdoors	Elementary and Middle School	Investigation/ Inquiry	Rural or Urban	7, 14, 15
6	Streamflow	Upper Elementary to High School	Investigation	Rural or Urban	4, 7, 14, 15
7	Assessing Water Quality	Elementary	Investigation	Rural or Urban	14, 16
8	Landscape Survey: Playground - "My Favorite Place"	Early Elementary	Observation/ Investigation	Rural or Urban	3
9	Land Use Survey: Street Frontage Analysis	Upper Middle School	Investigation	Urban	12, 3; AP I, VII
10	Land Use Survey: Transportation	Middle School+	Investigation	Urban	12, 15, 18; AP I, II, VI, and VII
11	Land Use Survey: the Local Shopping Mall	Middle School	Investigation	Urban	3, 1, 8
12	Traffic Flow Survey	Elementary	Investigation	Urban	3
13	Land Use Survey: Urban Sleuthing with Maps and Photos	High School	Inquiry	Urban	17, 18; and AP VI and VII

+ = Appropriate at and just above the indicated level

Fieldwork #1
Basic Observation Skills

Overview:

The purpose of this exercise is to engage students in developing observation skills. Teachers have used these exercises with students from kindergarten through the master's degree level. Although the more sophisticated students generally perform better in both observing and describing, they usually omit some critical factor! The design of this activity is for classroom use and can take from one-half hour to a few hours depending on extensions you choose to use.

Grade Level: All grade levels

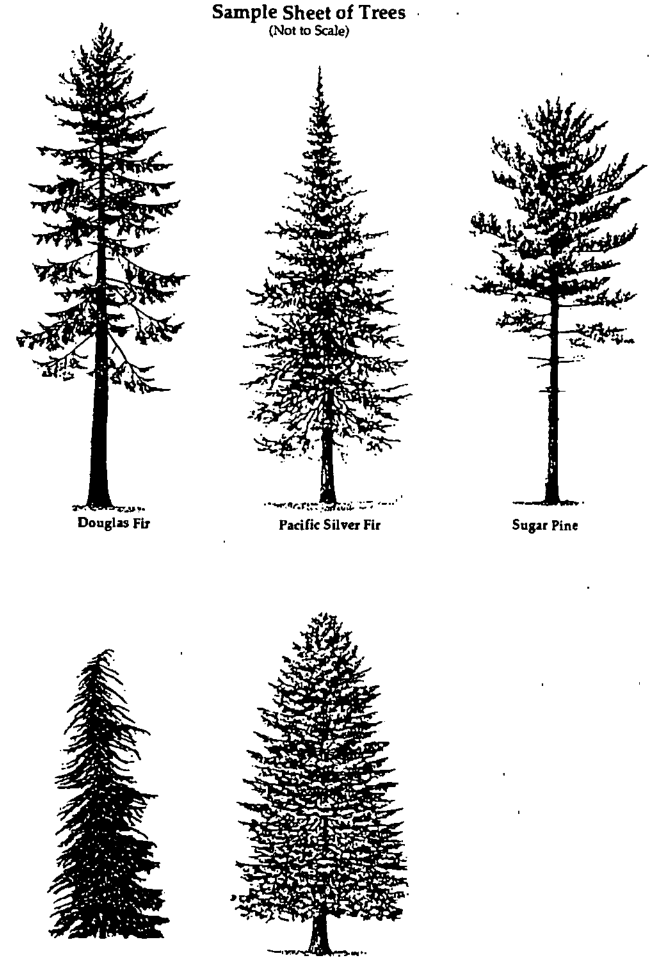
National Geography Standards addressed: Observation skills relate to most of the geography standards.

Geographic skill addressed: Basic observation skills

Objectives:

The overall objective of these exercises is to give students an opportunity to hone their observation skills. Students can work individually, in groups, or as an entire class. Teachers can tie the exercises to building vocabulary (e.g., naming parts of a tree), writing skills, and literature (see Extension below). Encourage students to be as descriptive as possible. Students often need to work on stating the obvious: one group of students asked to describe a pine cone gave no indication of its size or color, since they became focused on its scales!

Sample Sheet of Trees
(Not to Scale)



Specific objectives:

Students will (a) describe (orally or in writing) the characteristics of an object or set of objects; and (b) compare characteristics of objects.

Materials and equipment:

a. One exercise requires that each student or group of students have an object to observe.

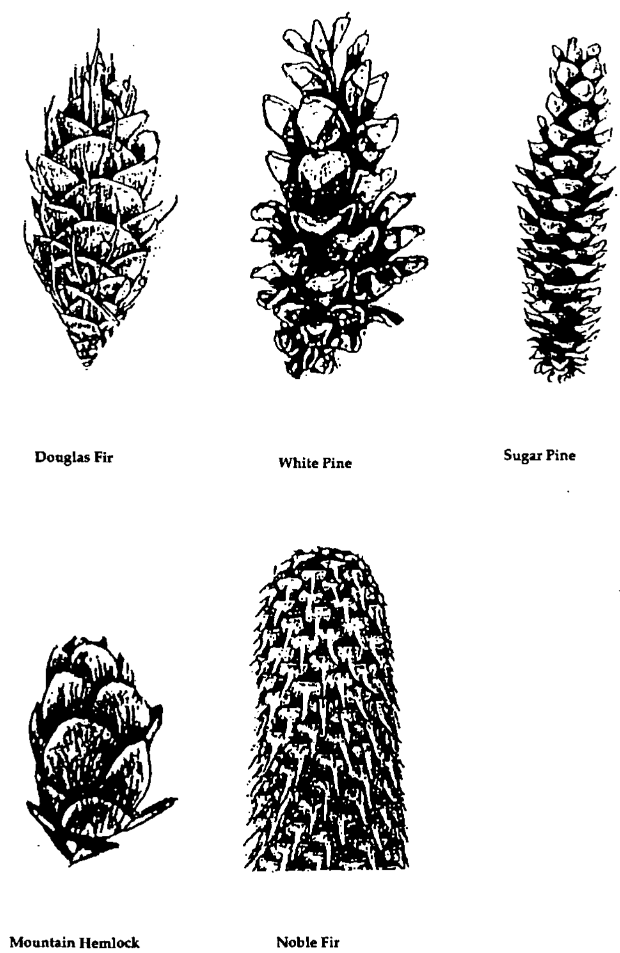
b. The second exercise requires any collection of similar yet individually distinctive items: different tree species, pine cones, leaves, etc. You can use the real objects, such as pine cones, or you can use silhouettes (such as tree outlines) or pictures.

Procedures:

a. For the first exercise, ask the students to describe the object without naming it. For example, if you give the students Douglas fir cones, they should describe the cones in detail (all aspects of color, shape, size, etc.) but not identify the object as a pine cone. Students can compare lists, or compile a composite list with the best descriptors. If the students work in two groups (and cannot hear each other working) then you can give each group a different object to describe (e.g., a pine cone and a monkey wrench). The groups can then switch lists of descriptors, with the assignment to draw or identify the object described by the list.

b. Give the class a collection of items (or pictures or silhouettes; see sample sheets of trees and pine cones). Ask the class to list all the ways in which the items are alike and all the ways in which they are different. It helps focus the students' attention if you do not ask them to try to identify the particular species of plant or leaf: rather work with them to describe the item's characteristics. If each item has a distinctive characteristic then students can use that as a means to identify the item in the field. For example, the sample sheet displays silhouettes of five conifers. A distinctive feature of the second conifer is that its leader, or highest tip, droops. This is a distinguishing characteristic of mountain hemlock and is an easy way to spot them in the field.

Sample Sheet of Cones
(Not to Scale)



Presentation suggestions:

Students can make composite lists and sketches, as well as write descriptive paragraphs about the items and the comparisons.

Extensions:

You can tie observation exercises to literature particularly for young students. They can read (or you can read) a story that features a particular object, preceded or followed by an observation exercise that helps fix that feature in their minds. This will help them build identification keys for later fieldwork. For example, students can use the conifer species exercise, followed by a retelling of the Native American tale of Hemlock (attached) that helps students remember mountain hemlock is the tree with the drooping leader (and small cones). Similarly, you can relate Douglas fir cones to the "Magic Cloak" story (attached).

Trees: The Story of Mountain Hemlock

Many moons ago none of the great forest conifers had cones. Neither Douglas fir, nor pine, nor cedar, nor hemlock, nor firs, nor redwoods, nor any of the other great trees of the forest had cones. The trees had grown for many moons, but had no seeds to grow new trees.

One day the gods of the forest called all the conifers together and said to them: "We love all the great conifers of the forest. Your branches and needles provide homes and food for so many of the animals of the woods, and when we sprinkle you with snow you shimmer with beauty as you reflect the sun. We want you to thrive and produce many young conifers. So we will give each of you cones with seeds!" At that point, the gods built a large table out of branches, twigs, and needles, and invited the conifers to step forward for their cones!

With great excitement all the conifers ran to form a line, and began to approach the table to receive their cones. Hemlock, who was a bit of a bully, decided that he wanted to get the biggest cone in the forest, which he figured would be the first to be handed out. So he jostled and pushed his way to the front of the line, finally stepping in front of Sugar Pine at the very beginning of the line. But the forest gods had their eye on Hemlock, and when he arrived at the front of the line they scolded him, saying "Shame on you, Hemlock! You are a bully! And selfish! And much too proud! Shame on you for pushing all the other conifers out of the way. You go to the back of the line!"

And so Hemlock did. Sugar Pine, who was then first in line, received the largest cone in the forest. Longer than your foot! And so on down the line the cones were distributed. By the time Hemlock finally arrived at the table, the only cone that was left was a little egg-shaped cone, as small as your thumb. But the gods weren't done with Hemlock yet! They scolded him further, saying "Hemlock, it was very bad of you to behave like such a bully, pushing and shoving the other trees around like that. We're not sure you've learned your lesson even though we have given you the smallest cone! So as a reminder of your bad behavior, you and all of your descendants will forever hang your heads in shame!" And until this day, whenever you see a mountain hemlock in the forest, you will see that it hangs its head in shame.

(An oral tradition story, as told by a Native American storyteller to T. Bulman at the Warm Springs Museum, Warm Springs Reservation, Oregon.)

Magic Cloak: The Story of Douglas Fir

Many moons ago there was a kind and generous Indian girl who lived with her people at the foot of the mountains. Her job was to collect berries and fruits from the forest. Her great-grandmother had given her a cloak to keep her warm and in which to carry all the fruits and berries home. In fact, it was a magic cloak, given to her people by the forest gods! Wherever she placed it down on the forest floor, nuts and berries could be found all around!

In time, the Indian girl became a friend to all the animals in the forest. She shared her food with them, and they would visit and play with her when she came to the forest.

One day when the girl was collecting nuts and berries, a terrible storm broke over the mountain. Thunder and lightning all around! A huge bolt of lightning struck a mighty tree, and the tree caught on fire. Quickly the forest began to burn. The animals and the Indian girl ran away as fast as they could, but the fire was so big and moved so quickly, they could not get away. Tired and exhausted, the girl stopped, and so did all her animal friends. Chipmunk shouted, "If we all hide underneath the magic cloak then surely the fire will go right over us and do us no harm!" But as all the animals ran under the cloak it quickly became clear that there would be no room left for the Indian girl. She had to either save herself, or save all her friends. She didn't hesitate: she threw the cloak over all of her animal friends so they would be safe!

When the fire finally died down, the gods of the forest saw all the animals slowly creeping out unharmed from under the cloak. The gods called all the animals together and said: "We want to honor the young Indian girl, whose great bravery and generosity saved you all, all her friends that she safely hid under her magic cloak. And so, we will take the most magnificent tree in the forest— the great Douglas fir— and we will make his cone reflect her moment of bravery."

And so, to this day, the Douglas fir cone has little bracts under its scales that look just like little animals hiding underneath a magic cloak.

(An oral tradition story, as told by a Native American storyteller to T. Bulman at the Warm Springs Museum, Warm Springs Reservation, Oregon.)

Fieldwork #2

Rosie's Walk: An Observational Walk

Overview:

In this activity, kindergarten students learn directional vocabulary, learn to follow verbal directions culminating in a guided walk around their school where they observe their surroundings and record their observations by drawing pictures. The activities can span over several days.

Grade level: Preschool to Grade 1

National Geography Standards Addressed:
#4. The physical and human characteristics of place.

Geographic Skills: How to make observations; how to follow directions

Grade Level: K-1

Objectives: Students will:

a. learn directional vocabulary including right and left;
b. follow verbal directions and directional arrows to get to a set point;
c. follow a trail and observe and record their observations through drawings.

Materials and equipment:

Pat Hutchins 1986. *Rosie's Walk.* New York: First Aladdin Paperbacks Edition.
Large cardboard arrows.
Sheets of paper labeled 1 Right, 1 Left, 2 Right, 2 Left, 3 Right, and 3 Left.
Three large red cardboard stop signs.
String or chalk

Procedures:

Activity 1

a. Read the story *Rosie's Walk* to the class.
b. Discuss the key directional words used in this study—*over, under, around,* etc.
c. Introduce the words *right* and *left* and give students opportunities to practice using those terms.
d In the classroom or playground, set up a simulated walk that follows the same sequence of directions Rosie took. Tell the students to pretend they are Rosie and that they will be taking a similar walk. Lead the class through the walk by giving verbal directions.

Activity 2

a. Put the students in pairs and give each pair a large arrow.
b. In the playground, ask the students to walk so many paces, turn in different directions—*left, right, in front, behind*—with their arrow pointing in the assigned direction.
c. Ask the students the following questions:
   What can you see?
   What is your arrow pointing to?
   Where are you facing?
   What are you next to?
   What is behind you?

Activity 3

a. Create a string or chalk train with three stopping points. Mark each of the stopping points with red symbols.
b. Ask the students to go in pairs to each stop and look to their *right*. On the sheet marked **1 Right**, one of the students will draw what he or she sees in that area. The pairs then change directions and turn to the *left* and on the sheet marked **1 Left**, the second students draws what she or he sees. They repeat this process for each station.
c. Back in the classroom, use a large wall to tape the pictures for **1 Right** together in a group, the ones for **1 Left** in another group, etc.
d. Ask the students to look at each group of pictures. Talk about the similarities and differences in the pictures in terms of what the students observed.

Adapted from: Milner, A. M. 1986. *Geography Starts Here!* Sheffield: The Geographical Association: 18-21.

Fieldwork #3
Mapping a Trail or Area

Overview: In this field exercise students will construct a map of a trail or an area. The first part of the fieldwork involves gathering data in the field using tape measures and compasses to measure distances and angles. The second part consists of the conversion of the field data into a map. Just about any site will do: the classroom, any place in the schoolyard, or any site that has either a trail or an area where students can work without interfering too much with other users of the site. For young students, a small area such as a basketball court or part of a playground will be challenging enough; older students can take on extensive trails or complicated areas.

Grade Level: Upper elementary through high school

National Geography Standard addressed:
#1. How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective

Objectives:
Students will:
a. use compass and tape measures to record angles and distances.
b. organize geographic mapping data using data sheets.
c. use map data by translating field data to make maps.
d. work with questions of scale (and at upper grades, questions of triangulation).
e. use cartographic techniques to create and present maps.

Materials and equipment:
For the entire class:
Tape measures for each group (preferably 30-50 meters or 100 feet long)
Flag markers (or hand-made flag—a meter or yard stick with a small paper flag or index card attached—will do fine)
Protractor for each group
Large sheet of butcher block paper for each group

For each student:
Data sheet
Clipboard and pencil
Compass

Procedure:
In-class preparation:
This exercise assumes that the students have had a general introduction to how a compass works. If triangulation will be used to make an area map, this concept will also need to be explained; map making is a wonderful example of how to apply the concept.

As part of in-class preparation, students can hand-draw a model of the area to be mapped. These sketch maps have several purposes: as an example of mental maps (for comparison later on to the real map); to give the students a general sense of what their map will look like—the general shape of the trail or area they will map (this will be particularly useful when the students begin to make the map and have to figure out scale); and as a handy guide for locating where the numbered flags have been placed at the site.

The students (or teacher) should then place the flag markers, labeled in large numbers consecutively from flag #1, along the trail or along the perimeter of the area, making sure that a student standing at one flag can see the next consecutive flag clearly.

Gathering the data:

Demonstrate how to use compasses and how to take a reading from one point or mapping station to another.

Pairs will practice using their compasses by taking readings from each other. Have partners stand at opposite flagging stations and take compass readings of each other. Their readings should be 180 degrees different (students can use this as a way to judge the accuracy of their readings).

When the pairs are proficient and comfortable using their compasses and taking readings, it will be time to map the area or trail.

Hand out field sheets that have pre-assigned mapping stations for each pair. Assign each pair to a starting set of two stations and each pair will migrate to other stations in the order on their field sheet.

Each pair must get accurate compass readings from the mapping stations to which they are assigned. One partner will take a reading from the source mapping station to the destination mapping station while the other partner will take the reading from the destination mapping station back to the source mapping station. Each pair will record both readings on the field sheet. Their readings each time should be 180 degrees different. Allow some rounding (up to 5 degrees or so) especially for younger students.

The students then need to take a distance measurement between the stations. If you are mapping a trail, students will have to take distance measurements between each station. If you are mapping an area, you can measure distances between each set of stations, or you can measure only the distance between the first and second stations. This will be the baseline from which you can do triangulation for all the other mapping stations if you are mapping an area.

Making the map:

Compile all the field sheets. For each group have ready a ruler, a protractor, several sharp pencils, and a large sheet of white paper.

The first task for the students is to determine the scale of the map. The best way to do this is to determine the longest distance between points in the mapping area and then adjust the scale to best fit the sheet of paper. When choosing the scale be sure to leave lots of margin on the paper. Some trial and error may be needed here.

Trail map:

Using the sketch map as your guide, and labeling the top of your blank sheet as the direction North, place the first mapping station on your sheet. (Example: if the first mapping station is located in the northwest corner of the mapped area, place this first mapping station in the upper left portion of the sheet).

First determine the angle of the line between the first two stations. All degree measurements center around North which is 0 and 360 degrees. Place the protractor so that 0 degrees is towards the top of the page (North), and then place a small pencil tick mark at the number on the protractor that corresponds to the degree measurement of your first station reading. (Be sure your protractor is placed directly North-South, use the straight edge of the paper to line up the protractor.)

Now place the ruler on the straight line from the mapping station through the tick mark. Convert the distance measured between the two mapping stations to the scale of the map. For example, if the distance is 10 meters (or 10 feet) and the scale is 1:10, the line would be 1 meter (or 1 foot) long. Draw the line at the correct distance. Place a dot on the end of the line, and label this station. Continue for each set of stations until the trail is finished. The map can then be enhanced with appropriate cartographic material. Note that the ruler will make the trail appear as a series of straight lines; some interpolation (or artistic license) may be used to make the map more realistic.

Area map:

Follow the procedure for a trail, or use the following triangulation process. Gather the angle and distance measures from the two mapping stations that were measured with a tape measure. These are your base stations and your baseline. Using the sketch map as your guide, and labeling the top of your blank sheet as the direction North, place the first mapping station on your sheet.

First determine the angle of your baseline. All degree measurements center around North which is 0 and 360 degrees. Place the protractor so that 0 degrees is towards the top of the page (North), and then place a small pencil mark at the number on the protractor that corresponds to the degree measurement from the first station to the second. (Be sure your protractor is placed directly North-South, use the straight edge of the paper to line up the protractor.)

Now place the ruler on the straight line from the first mapping station through the tick mark. Convert the distance measured between the two mapping stations (let's call them A and B) to the scale of the map. For example, if the distance is 10 meters (or 10 feet) and the scale is 1:10, the line would be 1 meter (or 1 foot) long. Draw the baseline at the correct distance. Place a dot on the end of the line, and label these mapping stations appropriately (A and B).

From these two established mapping stations, you can draw angle lines from each station to each of the other stations using the compass readings collected. Instead of drawing a line a specific distance, just draw a line that extends from the base station to the edges of the paper.

When two lines drawn from the two separate mapping stations (A and B) to the same third mapping station converge, that will be the location of that new mapping station.

When you have connected all the intersected lines, you will have a map of the area.

You can then erase the excess lines, or transfer the map to a clean sheet of paper. You will need to interpolate the shape of the curves in the area so that the map does not appear to be a series of perfectly straight lines.

Presentation models and assessment: The principal presentation is the map itself, along with any text, photos, or other materials. You can prepare the sketch maps of the site prepared in class ahead of time and can incorporate them in the presentation.

Extensions:

Students can make maps of trails or areas as a community service project for local parks, playgrounds, or other civic venues.

Mapping Field Sheet—Area

Student Name: ________________________ ________________________

Record your angles and return angles (set of angles should differ by 180°)

From mapping station 1 to 2: ___°

From mapping station 1 to 3: ___°

From mapping station 1 to 4: ___°

From mapping station 1 to 5: ___°

From mapping station 2 to 3: ___°

From mapping station 2 to 4: ___°

From mapping station 2 to 5: ___°

From mapping station 2 to 1: ___°

From mapping station 3 to 1: ___°

From mapping station 4 to 1: ___°

From mapping station 5 to 1: ___°

From mapping station 3 to 2: ___°

From mapping station 4 to 2: ___°

From mapping station 5 to 2: ___°

Base line distance (from Station ___ to Station ___): ____________________

Distance from 1 to 2 ______

Distance from 2 to 3 ______

Distance from 3 to 4 ______

Distance from 4 to 5 ______

Mapping Field Sheet—Trail

Student Name: ________________________ ______________________

Record your angles and return angles (set of angles should differ by 180°)

From mapping station 1 to 2: ___° station 2 to 1: ___° Distance: _____

From mapping station 2 to 3: ___° station 3 to 2: ___° Distance: _____

From mapping station 3 to 4: ___° station 4 to 3: ___° Distance: _____

From mapping station 4 to 5: ___° station 5 to 4: ___° Distance: _____

From mapping station 5 to 6: ___° station 6 to 5: ___° Distance: _____

From mapping station 6 to 7: ___° station 7 to 6: ___° Distance: _____

From mapping station 7 to 8: ___° station 8 to 7: ___° Distance: _____

From mapping station 8 to 9: ___° station 9 to 8: ___° Distance: _____

From mapping station 9 to 10: ___° station 10 to 9: ___° Distance: _____

Fieldwork #4
Landscape Observation

Overview: This activity is an effective beginning step for training students to be discerning observers, or developing their *geographic eye*. Ideally, the teacher should carry it out in a relatively open area where students can see in all directions, such as an open field or top of a hill. Before this activity, review with students the difference between human and physical characteristics. During this activity students will observe and record both physical and human characteristics while facing the different cardinal directions of the field study site.

National Geography Standards addressed:
#4 The physical and human characteristics of places

Grade Level: K-4

Objectives:
At grades K-2 students will orally describe human and physical characteristics of the field study site.
At grades K-2 students will analyze what they have seen and answer the teachers questions orally.
At grades 3-5 students will sketch one view of the human and physical characteristics of the field study site.
At grades K-2 students will analyze what they have seen and answer the teachers questions orally.
At grades 3-5 students will accurately join their drawing with those of their classmates to create a diorama in-the-round of the field study site.

Materials:
Large compass arrows for all cardinal directions.
Clipboards
Blank paper
8"x10" cardboard frames for viewing the landscape. These can also be made with coat hangers pulled into a viewing square.

Procedures:
Grades K-2
1. Make large compass arrows for each child in your class. Mark 1/4 of them North, 1/4 of them South, 1/4 of them East, and 1/4 of them West.
2. Review with the class the difference between human and physical characteristics. Tell them that they will be geo-explorers and make observations (look at) _________________________ as a place and field study site.
3. Choose a location that is in the middle of the field study site. Pass out the arrows to the students. With the aid of a compass, have the group with the North arrows stand in a line and face North. After they are in a line, have students put their arrows on the ground facing North. The rest of the class should sit in front of them and face the same direction. The students that are facing North are to tell the teacher everything that they observe (i.e., type of buildings, signs, plants, animals, transportation routes, water features, building materials, people, etc). The teacher is to record everything that the students in turn tell him or her. The students that are seated are asked to remain silent and just observe. After the North group is finished, the other students can name things that were not mentioned.

4. Next, have the students with East arrows stand in a line and face East. Repeat the same process as listed above. Do the same for South and West.

5. After this is complete, engage the class in a discussion about what they learned about this place. On a large piece of chart paper, record their answers. Guide them with questions. The questions you ask will depend on the type of area they are observing. In a park, for example, you might use these questions:

- Do many people use this place? What have you observed that helps you answer this question?
- What do you see that helps people get to this place?
- Do you think this place is pretty? Why or why not?
- What have you seen that people have placed here? What was not put here by people?
- Do you see anything that shows that this place has changed or is changing?
- How is this place like other places? How is it different?

Grades 3-5

1. Review with the class the difference between human and physical characteristics. Tell them that in the field they will work in teams of two using their powers of observation to study the physical and human characteristics of the field study site.

2. Divide the class into teams of two. Pass out a clipboard with two pieces of sketch paper attached, an 8" x 10" cardboard frame, and a pencil to each team of two students.

3. Choose a location that is in the middle of the field study site. With the aid of a compass, locate North. Have 1/4 of the class face North, 1/4 face West, 1/4 face South, and 1/4 face East. Students will sit in that location and take two minutes to observe *only* what is directly in front of their eyes before drawing. At the end of two minutes the teacher will instruct the class to start sketching only what is directly in front of their eyes, taking in as much detail as possible. Make sure that they make a note in the top right hand corner the direction they are facing while they sketch. One student will hold a frame approximately two feet in front of the student that is making the sketch. Note: The frame helps focus the student; without it the eyes tend to wander around a large area. The student holding the frame is not to give verbal prompts to the student sketching. Encourage students to write the colors that they see down on their sketch. Give them a minimum of ten minutes to work on this sketch. After approximately ten minutes have passed have the students exchange places and the other student will sketch (see example of sketch below from a field log).

4. After this is complete, engage the class in a discussion about what they learned about this place. On a large piece of chart paper record their answers. Guide them with the following questions:

- How have people changed the landscape here?
- What do you think the physical land was like before it was changed by humans?
- What kind of building material is used? Why?
- What signs of transportation do you see?
- Are there any indications of how people make their living?
- Are there any signs of different cultures?
- Are there any plants? If so, what do you think determined their being in this place?

5. Investigating historical land use in a cemetery.

- Do animals other than humans use this place? If so, how do they get the things they need to live?
- Do you see any indications that this place is changing or has changed over time?
- Why do you think people would like or not like this place?
- What conclusions can you draw from this experience?

5. When you return to class, divide the class into two parts—the group that sketched first and the group that sketched second. Remind the class which directions in the classroom are North, South, East, and West. Have each group arrange themselves and their pictures in the right order to represent a *picture in the round* of the field study site. If wall space is available, have students tape their sketches to the appropriate wall in the correct order. This will generate discussion about how we all see things differently.

Extensions for Higher Grade Levels:

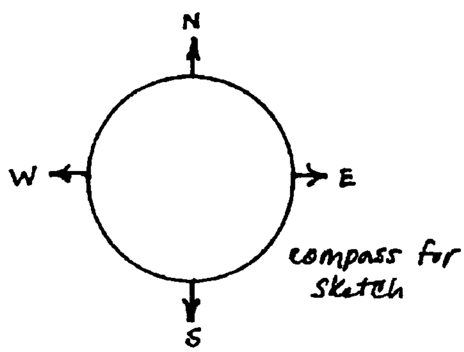
Older students in urban or rural landscapes can complete this activity. In addition to observing and analyzing what they see, they can speculate on future changes in the landscape or look for correlations between models studied in class and the patterns they observe in the field.

Sample Page from a Field Log

Date: October 12, 1996
Time: 2 PM
Place: Malheur Field Station, SE Oregon

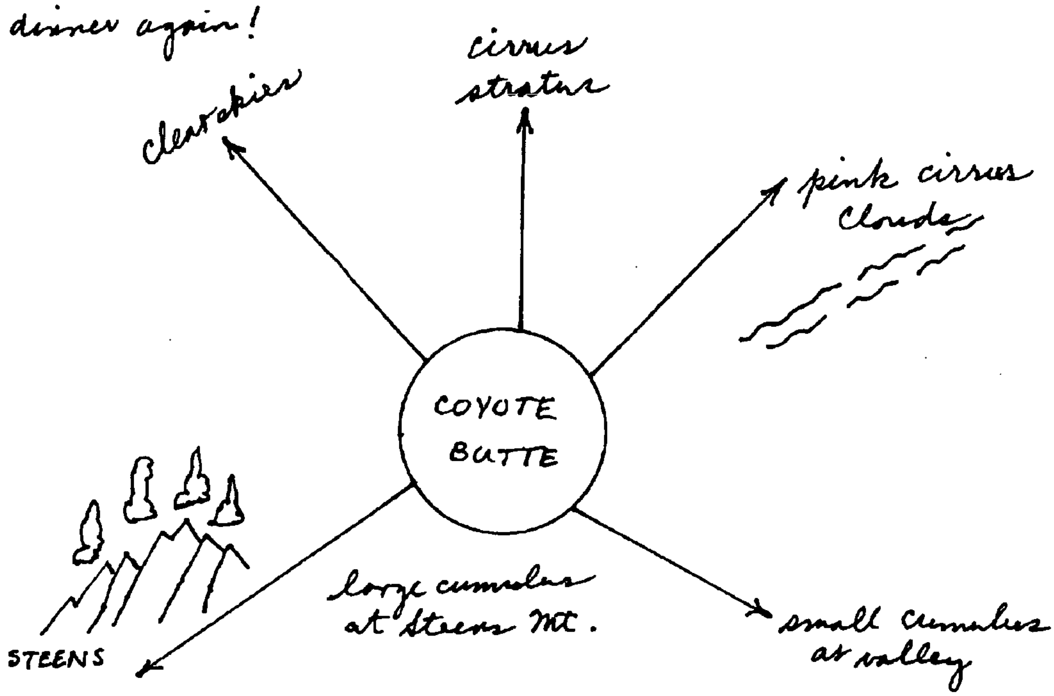
I am standing on the top of Coyote Butte (elev. approx. 4,500 ft.) having just climbed up to the one-mile nature trail. It is hot (around 80°) and the sky is clear. I have a 360° view from here.

I'm here to take cloud observations. At this time of the year rain falls in the high desert and clouds vary in form from the flats to the mountains. My observations from 1PM to 2PM are as follows.



There were a variety of clouds and some Clear sky. More clouds were around the high mountain than anywhere else. The clouds were moving very slowly. Most had slightly grayish or pink tinges.

I'll return to base now. I hope we won't have franks and beans for dinner again!



Fieldwork #5

Microclimates: Indoors and Outside

Overview: Elementary and middle school students can evaluate the effects of solar radiation on temperature and humidity, as well as how structures and vegetation influence temperature and humidity. Students can use thermometers and sling psychrometers for this activity, although more expensive hygrometers are easier (and safer—since they contain no glass parts!) for young children to read and use. This exercise has three parts, each of which students can accomplish independently: indoor microclimates, outdoor microclimates, and dark vs. light surfaces.

Grade Level: Elementary and middle school

National Geography Standards addressed:
#7. The physical processes that shape the patterns of Earth's surface
#14. How human actions modify the physical environment
#15. How physical systems affect human systems

Objectives: The main objective of this fieldwork is to understand how climate varies at a local scale.
Students will
a) collect data on temperature and humidity from a variety of sites.
b) organize the geographic data.
c) analyze the data, noting contrasts and similarities.
d) consider the factors that affect microclimates, indoors and outdoors, particularly the effects of solar radiation and humidity.
e) present their findings using graphic and cartographic skills.

Materials and equipment:
For in-class preparation exercise (dark vs. light surfaces):
Heat lamp [or reflector lamp with 100 watts (or greater) bulb]; on a very sunny, hot day, you can place the cups near a sunny window instead of using a heat lamp
1 dark metal can or cup (painted or purchased from science supply company)
1 silver or white metal can or cup (painted or purchased)
2 thermometers (alcohol-filled preferable)
2 insulated lids (purchased, or use 1-2 cm (0.4-0.8 in.) thick Styrofoam, cut to fit)
Data sheets
For indoor microclimate:
Map of classroom or school building (can be hand-drawn by students)
Thermometers (one per student group)
Sling psychrometer (one per student group)
(Students can use hygrometers instead of thermometers and sling psychrometers)
Data sheet
For outdoor microclimate: same as indoor except map should be of the outdoor site.
(Optional equipment: rain gauge, soil thermometer and wind meter or anemometer)

Procedures: This exercise assumes that the students have had a general introduction to weather, solar radiation, temperature and humidity. Students need to understand the concept of absorbtivity (dark surfaces absorb more heat and light more rapidly than light surfaces); middle school students can be introduced to vocabulary such as *albedo* (the fraction of radiation that a surface or body reflects). For in-class preparation, review the procedures and data sheets with the students, introducing any new vocabulary words and explaining how they will use the data sheets.

1. *For the in-class exercise comparing dark and light surfaces:* The students will study the scientific basis of something with which they have practical experience: dark surfaces are hotter than light surfaces on a hot day (consider bare feet on asphalt vs. cement surfaces, or black cars vs. white cars in the hot sun). They will measure the rate of temperature increase using two different surface colors.

Cut small slits on the insulated lids. Slide the thermometers through the slits, and place the lid on the cans.

Record the initial temperature (Time = 0) in each can (the temperatures should be identical). Place the cans side-by-side, about 10 cm (3.9 in.) from the heat source (lamp or window). Place the cans in such a way that the students do not need to disturb the cans in order to take temperature readings. Turn on the heat lamp.

Record the temperatures at fixed intervals (five minutes is recommended)

Students analyze the findings and discuss: Was there a difference between the cans? Which surface heats more quickly and why? What predictions can you make about other light or dark surfaces (clothing, cars, sidewalks, etc.) and what choices would you make based on the weather?

2. *For the indoor microclimate exercise:* Students will determine if different parts of the school building or classroom have different temperature and humidity levels (students can think of this in terms of comfort levels—the coldest spot in the room vs. the warmest spot). Because so many buildings are climate controlled, this works best if the students select sites that are as different as possible. Examples of contrast include: dark, enclosed closets vs. a spot near a sunny window; bathrooms (which have some moisture content) vs. dry areas near heat sources. Different sections of a room often have enough contrast, especially if places in the room vary from high sun to high shade.

Using a map of the classroom or building (or data sheets), record the temperature and humidity at various intervals at the selected sites throughout the day.

Students should analyze the data to determine if temperature and humidity changed throughout the day, and at what rates.

Students can discuss their findings, considering: Why did (or why didn't) temperature and humidity change throughout the day? Why were the rates of change different or the same? Where is the most comfortable seat in the class (at any given time)?

3. *For the outdoor microclimate exercise:* Follow the basic procedure for indoor microclimate, although the outdoor variables can be more complex (different degrees of shade, vegetation cover of different types; paved surfaces vs. vegetative surfaces) giving the students a wider range of results. Outdoor temperatures are not controlled; the outdoor fieldwork is best done on a sunny, calm day, when the contrast among sites will be greatest.

Record temperature and humidity on the data sheets, noting the site characteristics.

Students analyze the data and discuss their findings, considering: What factors affected the results? Consider variables such as surface color, degree of shade, and closeness to water or moist vegetation.

Presentation suggestions: Students can use the data sheets as their primary presentation. Various graphs, showing rates of temperature increase or variability of temperature and humidity among sites, can be used. Maps of the data sites can also be incorporated in the presentation.

Extensions:

Students can develop and test hypotheses related to the fieldwork. For example: Which area in the room will be hottest? Will shaded areas be hotter or colder than sunny areas? Will vegetated areas be more humid than paved surfaces, such as basketball court?

Outdoors students can also measure soil temperature, wind speed, and rain variations at different sites.

Students can measure changes at a given time, or over a long period of time (weeks or an entire school year).

Students can focus solely on surface variations, measuring the temperature of as many different surfaces at the same time (then discuss *absorbtivity* or *albedo*).

Zoo extension: When visiting the zoo, students can measure temperature and humidity in different controlled environments (assuming the zoo has sites such as penguin houses, rain forest exhibits, tropical aviaries or other climate-controlled sites. The data can help students understand variations in ecosystems and in habitat needs of animals.

Microclimates Outdoors

Names: ______________________ Names: ______________________

Site: Identify and describe each site.	Time of day	Air temperature	Relative humidity — using hygrometer	Soil temperature	Dry bulb	Wet bulb	Relative humidity — using sling psychrometer
Location #1							
Location #2							
Location #3							
Location #4							

Microclimates Indoors

Names: ______________________ **Names:** ______________________

Site: Identify and describe each site, including degree of sunlight and closeness to water and air vents	Time of day	Air temperature	Relative humidity — using hygrometer	Soil temperature	Dry bulb	Wet bulb	Relative humidity — using sling psychrometer
Location #1							
Location #2							
Location #3							
Location #4							

Fieldwork #6

Streamflow: Estimation of Speed and Volume

Overview: The purpose of this fieldwork is to estimate streamflow at a given point on a stream. Streamflow calculations are vital for flood control (helping to predict flood conditions), irrigation (water availability is estimated by streamflow), reservoir regulation, and river regulation (for water sports such as whitewater rafting). Just about any stream site will do. Keep in mind, however, both safety (avoid fast, deep streams) and the fact that if you are going to measure volume, students will need to be able to throw a rope across the stream (and if possible wade across the stream).

Grade Level: Middle school through high school

National Geography Standards addressed:

- # 4. The physical and human characteristics of places
- # 7. The physical processes that shape the patterns of Earth's surface
- #14. How human actions modify the physical environment
- #15. How physical systems affect human systems

Objectives: The main objective of this fieldwork is to introduce students to streamflow measurements of speed and volume. Students will

a) formulate hypotheses about streamflow.
b) measure streamflow and complete data sheets in the field.
c) use math skills to calculate streamflow data.
d) organize and present streamflow data.
e) analyze their findings and discuss the implication of streamflow for urban and rural uses.

Materials and equipment:

For the class (or each group):
- Measuring tape (at least 30 meters or 100 feet long)
- Meter or yard sticks
- 3 corks or large pieces of orange peel
- 3 stopwatches
- String or cord (2 pieces, each long enough to reach across the stream; tie a rock or very small sand bag weight to one end of each section of string)

For each student:
- Clipboard and pencil
- Graph paper

Procedures:

In-class preparation:

Teachers can use this fieldwork as part of a unit on floods, urban development, erosion, or a host of other human and physical geography topics. Students need to be familiar with measurements of speed and volume. In the United States, stream flow is measured in cubic feet per second; 1 cubic foot per second is referred to as a 1 second-foot flow and is a way of describing the quantity of water flowing past a given point on a stream in a given time.

The second-feet flow formula components are:

Cubic feet per second = <u>volume (cubic feet)</u> ÷ time (seconds)

Velocity = feet per second = <u>number of feet</u> ÷ (seconds)

Volume = mean width (W) times mean depth (D) times length (L)

In the field: Mark off 100 feet (about 34 meters) (L) of a stream section. You can use smaller stream sections if necessary. Throw a rope across the stream at the beginning and ending points of the stream section. (If the stream is shallow, students can walk the rope across the stream; you can also purchase or make ropes with small sand bags tied at one end, which are easier to toss and will hold fast.)

To measure speed: Toss the cork or orange peel into the water several meters upstream from the first rope (try to hit the center of the stream so the cork or peel has a better chance of floating the full distance). Measure the time it takes the cork or orange peel to cover the 100-foot distance and calculate the velocity of the water; repeat this measurement at least 5 times and calculate the mean (average) velocity.

To measure volume: Use the ropes to measure the width of the stream at several points in the 100 foot long stream section and calculate the mean width (W). Use the measuring sticks to measure the depth of the stream at several points in the stream section and calculate the mean depth (D).

Calculate the volume of the section you have measured V = W x D x L.

Now calculate Second-Feet Flow (1 cubic foot per second equals a 1 second-foot flow).

Presentation models and assessment: Students can use a variety of flow graphs, cross sections, and maps to present their findings, along with any text, photos, or other materials.

Extensions:

1. Students can measure and compare several reaches (segments) along the stream and graph the resulting calculations of flow (flow rate will change depending on the width or narrowness and shallowness or depth of the stream in each segment).

2. Students can measure the streamflow over a period of time (days, weeks, or academic year). They can use the comparative data to discuss seasonality of streamflow, effects of precipitation events, effects of riparian vegetation on streamflow, etc.

3. The United States measures water volume in acre-feet. One acre-foot is equal to the amount of water needed to cover an acre of land to a depth of one foot (325,851 gallons or 43,560 cubic feet). By using this standard, students can calculate how many acre-feet this stream produces in a 24-hour period:

1 cubic foot per second flow (times) 24 hours = 1 acre 2 feet deep = 2 acre-feet

6. Streamflow data collection by Markham Elementary School Oregon students.

Streamflow Calculations

Name: ______________________________

Stream name: ______________________________

Stream location: ______________________________

Date: ______________________________

Weather conditions (last 48 hours) ______________________________

Velocity:	**Seconds/100 ft**	
Trial 1:		
Trial 2:		Mean velocity = sum of trial times divided by 5
Trial 3:		To change "seconds / 100 ft. into feet / second," Divide velocity by Mean velocity
Trial 4:		
Trial 5:		
Mean velocity		

Width:	**feet**	**depth**	**feet**	**Volume:** ________ **cubic feet**
Point 1:	Point 1:			Mean width ( ) x
Point 2:	Point 2:			Mean depth ( ) x
Point 3:	Point 3:			Length (100) =
Mean width	**Mean depth**			**Volume**

Cubic feet/second: Volume/mean time

Fieldwork #7
Assessing Water Quality

Overview: The main objective of this field exercise is to collect samples of water from different sources, including different reaches of a stream, different streams, or different sites on a pond. Students will evaluate the water quality—degree of pollution—based on sight and smell. Students will discuss why variations in the water samples exist and what might have caused the pollution. Young students can gain an appreciation of the variability of water quality, and in the process learn basic observation skills. This activity will require no expensive instrumentation but you must be able to gain access to a stream or creek for sample collection. Although it is best for the students to do the sample collecting, lack of access or concerns about contaminated water, for example, may hinder this. Teacher-collected samples, however, can still serve as useful in-class observation skills exercises.

Grade Level: Elementary

National Geography Standards addressed:
#14. How human actions modify the physical environment
#16. The changes that occur in the meaning, use, distribution, and importance of resources

Objectives: Students will
a) analyze water samples based on sight and smell.
b) collect and organize data on water samples.
c) hypothesize about the variations in the characteristics of water samples.
d) present their findings, orally or in writing.

Materials and equipment:
Data sheets: visual and olfactory data sheets; map of stream (or other collection site)
Small clear bottles (glass or plastic): enough for each group of students to have one bottle, preferably with a wide neck and a tight lid
Water samples: One sample from tap water, and at least two other samples from different sources of different reaches of a stream (if the samples are numbered but unidentified then students can evaluate them without bias).
Rubber or latex gloves: for collecting samples from polluted sites
(Journal: if students collect the samples)

Procedures: This exercise assumes that the students have had a general introduction to water quality. For in-class preparation, review the data sheets with the students, introducing any new vocabulary and explaining how the students will use the data sheets. Using a map of the stream or other collection area, have the students locate the sample collection sites.

7. Testing water quality by Markham Elementary School, Oregon students.

Collect the water samples, including sediment, debris, vegetation or other materials floating in the water. If the students collect the samples, have them keep a journal noting where they collect each sample and the general characteristics of the sample site (the teacher can provide this if the teacher collects the samples).

Distribute the samples so that each group of students has at least three samples. If you want the students to perform a *blind evaluation*, number the samples but do not identify them. Students can later guess the nature and source of the samples. Otherwise, label the samples.

Students then complete the data sheets and discuss the results.

Presentation models and assessment: Students can use the data sheets as their primary presentation. They can also use bar graphs, showing degrees of pollution, for the visual survey. They can also incorporate maps of the data sites in their presentations.

Extensions:

Middle school extensions:

1. Have students identify appropriate sites for sample collection based on their development of relevant criteria for site selection (e.g., location of stream, land use along the stream, accessibility.)
2. Before they collect samples, have students develop hypotheses about whether the samples will vary, and why. Have students test the hypotheses and draw conclusions.

Elementary and middle school extensions:

1. If students collect the samples they can also measure stream temperature at each site and speculate as to why temperature varies along the stream.
2. Color charts and standardization: Elementary students can use color charts (e.g., Munsell-type charts*) to compare the color of particularly murky or algae water samples. This provides an opportunity for students to learn basic concepts of standardization as they form a group consensus about which colors apply to which samples.

Additional samples: Students can bring water samples from water bodies near their homes for evaluation in class.

Note: *Munsell-type charts are based upon a standard color identification system developed by A. H. Munsell in 1915 when he used three parameters—hue, value, and chroma—that correspond to the basic parameters, dominant wave length, reflectance, and purity to set up such a standard color identification system.

Water Data Sheet: Sight and Smell Observations

Student name ______________________________

Sample #	Color	Smell	Foams	Loose material

Color: To measure color, place the sample bottle on a sheet of plain white paper and compare the color of the water to the paper. Colors range from clear to blue to brown to variations of green.

Smell: Sniff the water (not too close!). Smell will range from none to mild vegetative smells to strong sewage and chemical smells.

Foams: Shake the sample bottle for at least 30 seconds; if foam appears, measure how long it takes for the foam to disappear. Polluted water has lots of foam.

Loose material: Some water has a lot of sediment or other debris material in it. To measure these materials, take a thick ball-point pen and draw a line on a piece of white paper. Place a clear, empty water bottle on top of line. Shake the water sample and pour it into the empty bottle. When the line disappears from view, stop pouring. Measure the depth of the water in the bottle. The greater the depth, the less polluted the water. Clean water = approx. 20 cm; heavily polluted water is less than 3 cm.

Water Quality Data Sheet: Water Pollution Visible Data

Sample number:						
Sample name:						
Very Clean	**5**	**4**	**3**	**2**	**1**	**Very Polluted**
Clear water						Lots of dirt in water
No loose algae vegetation						Lots of algae and weeds
Stones clean, no algae						Stones covered with algae or murky materials
No litter						Lots of litter
No strange colors in water or on algae						Strange colors in water or in algae
Sub-totals:						
Total points for this sample:						

Fieldwork #8
My Favorite Place

Overview: This activity helps young students to develop greater geographical awareness by tapping into their natural curiosity about their immediate world—the school playground. Students create a map of the playground and address the question of where on the playground most kindergartners or first graders like to play. They survey their class and one other class and tabulate the results by creating pictographs. Note: It is possible that the school administration may already have set up play sites or areas for different age groups. Students can also create pictographs of these sites or areas.

National Geography Standards Addressed:
#3. How to analyze the spatial organization of people, places, and environments on the earth's surface.

Grade Level: K-1

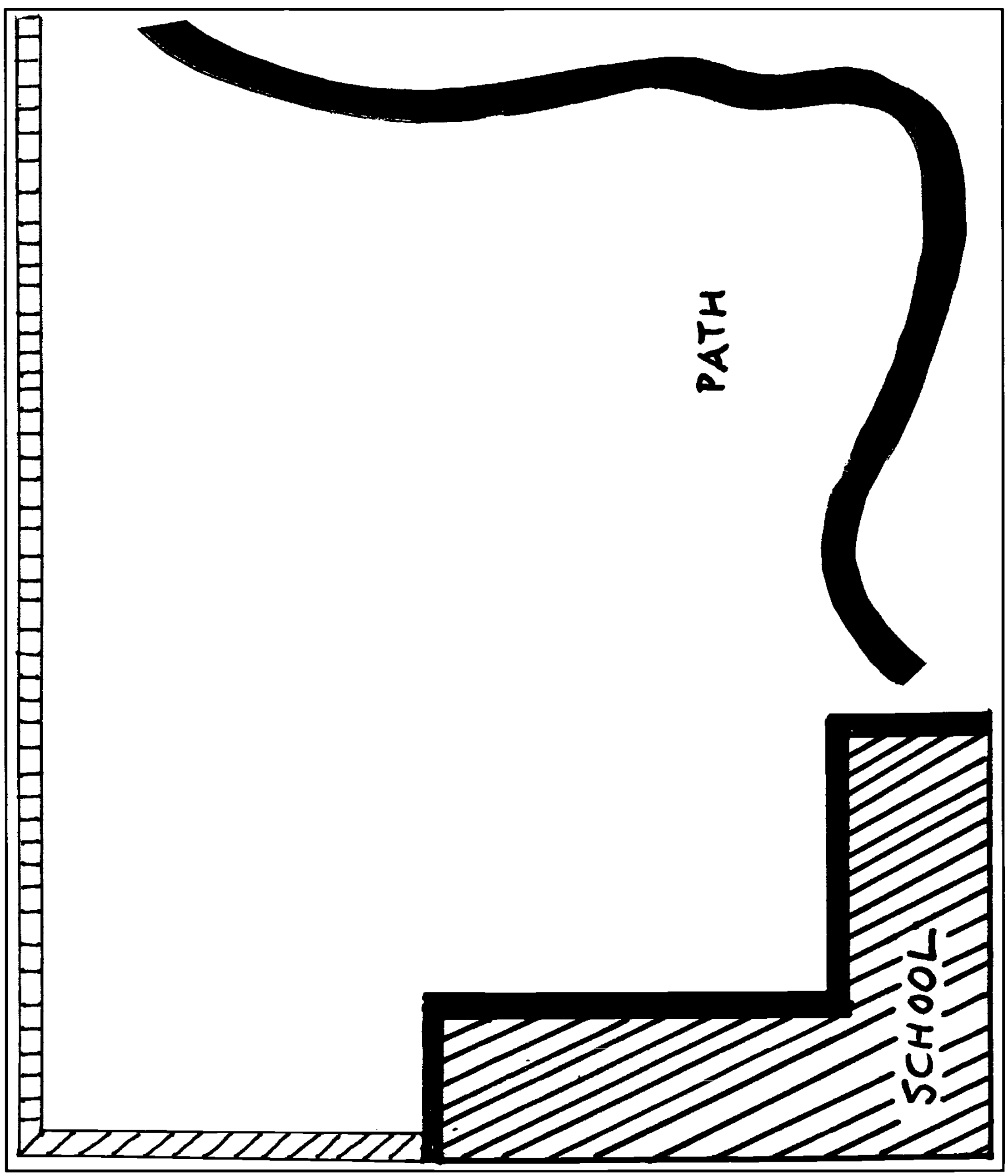
Objectives: Students will:
a) create, read, and interpret a map;
b) conduct a survey among fellow students;
c) graph and analyze the results of the survey.

Materials and equipment:
A large outline map of the playground drawn on butcher paper.
Pictures (photos, sketches, or symbols) of the playground structures on which students play.
Worksheets with map of the playground with rebus cues for the survey.
Avery™ dots in two colors.
Tape, glue, and pens or crayons.

Procedures:
1. Teacher poses questions to the class:
   - Where do you like to play at recess?
   - What is your favorite play structure on the playground?
   - Where do you think most students in this class or in another class like to play?
   - How could we find out?
2. Teacher takes the students to the playground and asks them to identify all the possible places to play on the playground—swings, tires, seesaws, etc.
3. Place on the ground a large butcher paper outline map of the playground that contains some landmarks to help orient the map. Ask the students to observe the location of one particular play structure on the playground (e.g., the swing), and ask them where it should be on the outline map. Paste a picture of that structure on the map in its correct location. Do the same for all the structures. The students will see the relationship between the actual playground and a representation of the playground—the map.
4. Ask the students to identify their favorite play structure and to place a red Avery dot on the map next to that structure to indicate their choice. Discuss the patterns that may emerge.
5. Tell the class that they will be surveying another class to identify their favorite structures. Match students from the class with students from the second class. Give each student a sheet that has a map of the playground and rebus cues of all the structures. The students are to ask their partners from the other class to look at the playground map and circle the picture of their favorite play structure.

6. In the classroom, the students place green Avery dots to indicate the choices of their partners from the other class.
7. Ask the students to count both sets of dots for each play structure. Using pictures of the play structures, they can create two sets of pictographs—one showing the choices of each class and one showing the combined results of the survey.
8. Students analyze their findings and brainstorm other ways they could have answered the question, "Where is your favorite place to play on the playground?"

Map of Playground

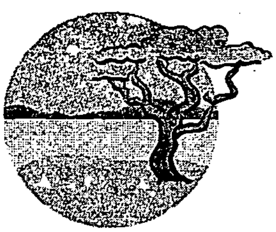


Student's Name ______________________________

Date ______________________________

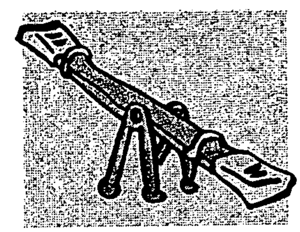
Where I Like to Play Best

Near the tree

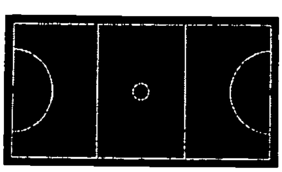


At the hoop

On the see-saw

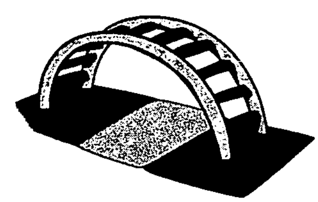


On the playing field

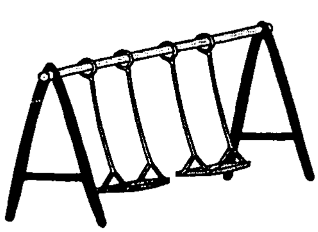


On the slide

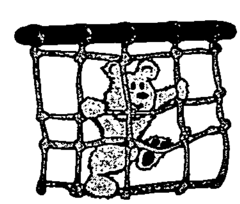
On the monkey bars



On the swings



On the climber



Students record with a sticker where seven students surveyed liked to play most.

Fieldwork #9
Land Use: A Street Frontage Survey

Overview: This fieldwork examines retail activity and other land use (*function categories*) in a downtown retail area. Students will collect data (measurements and counts), use maps, make maps, analyze data, and present the data in a variety of graphic forms. Students can make this frontage survey in any size city (and they have!) from small rural cities like Burns, Oregon (population 2,975 and falling) to large urbanized areas like Portland, Oregon (population 750,000 and rising). The map that follows this lesson shows the area investigated by five groups of students examining retail functions in Ashland, Oregon.

Grade Level: Upper middle school through high school

National Geography Standards addressed:
#12. The processes, patterns, and functions of human settlement
#13. How the forces of cooperation and conflict among people influence the division and control of Earth's surface

Connection to Advanced Placement content:
VI: Industrial and Economic Development
VII: Cities and Urban Land Use

Objectives: The main objective of this fieldwork is to introduce students to downtown retail functions and geographic theories related to urban geography. It also engages students in classifying and quantifying functional units (establishments) for presentation purposes. It assumes that the students have been introduced to concepts of spatial interaction and hierarchy of central places, including concepts of:

Central place: A settlement or location providing services such as public administration, retail-wholesale trade, financial services, and professional services (such as doctors and lawyers) over a large area.

Urban or central place function: A retail store or service establishment, sometimes referred to as a functional unit, in a central place; for example, several clothing stores in a central place provide the apparel function of that place.

Central Business District (CBD): Traditional center of a city; downtown, the commercial core where goods and services are offered for sale in a dense collection of establishments; usually the oldest part of a town, where land values are highest.

Threshold: The minimum amount of purchasing power necessary to support the supply of a good or service from a central place; usually measured by the number of persons per functional unit in the trade area.

Range of a good: The distance over which people are prepared to travel in order to obtain a particular good or service.

Specific objectives: Students will;
a) analyze the location and volume of urban retail functions.
b) identify, classify, measure and map retail functions in an urban setting.
c) analyze and present their findings using graphic and cartographic skills.

Materials and equipment:
For the class (or each group):

Measuring tape—30 meters or 100 feet long preferred. (Note: Students can pace off the distance instead of using a measuring tape if the students have learned to measure their pace with some degree of accuracy.)

For each student:

Clipboard and pencil

Maps

Data Sheets

Procedures:

In-class preparation: Discuss concepts, vocabulary and data gathering techniques.

Divide students into survey groups, one group for each section to be surveyed. Students should familiarize themselves with the map of their survey area, and with the function categories on the data sheet.

Data Collection: Students should survey their sections of the urban area, gathering street-level *frontage-foot* data by function on the data sheet. Note that students are observing only street-level functions, not upper floors. Students will probably come across functions that do not neatly fit into a particular category; they will have to make judgment calls, and should keep notes.

Presentation models and assessment:

When the data collection is complete, students should consolidate the field data from their survey area and from all survey areas combined. Using computer spreadsheets and a variety of graphic techniques, such as land use maps and pie charts, students can present the data and key findings, augmented by text, photos, or other materials.

Extensions:

1. If students each year do urban land use surveys at a school, and the records of those surveys (data and presentations) are kept, then students can compare changes in land use and function categories over time. Such longitudinal surveys can show dramatic changes within a few short years.
2. Students in one city can exchange data with students in another city for comparative urban analysis.

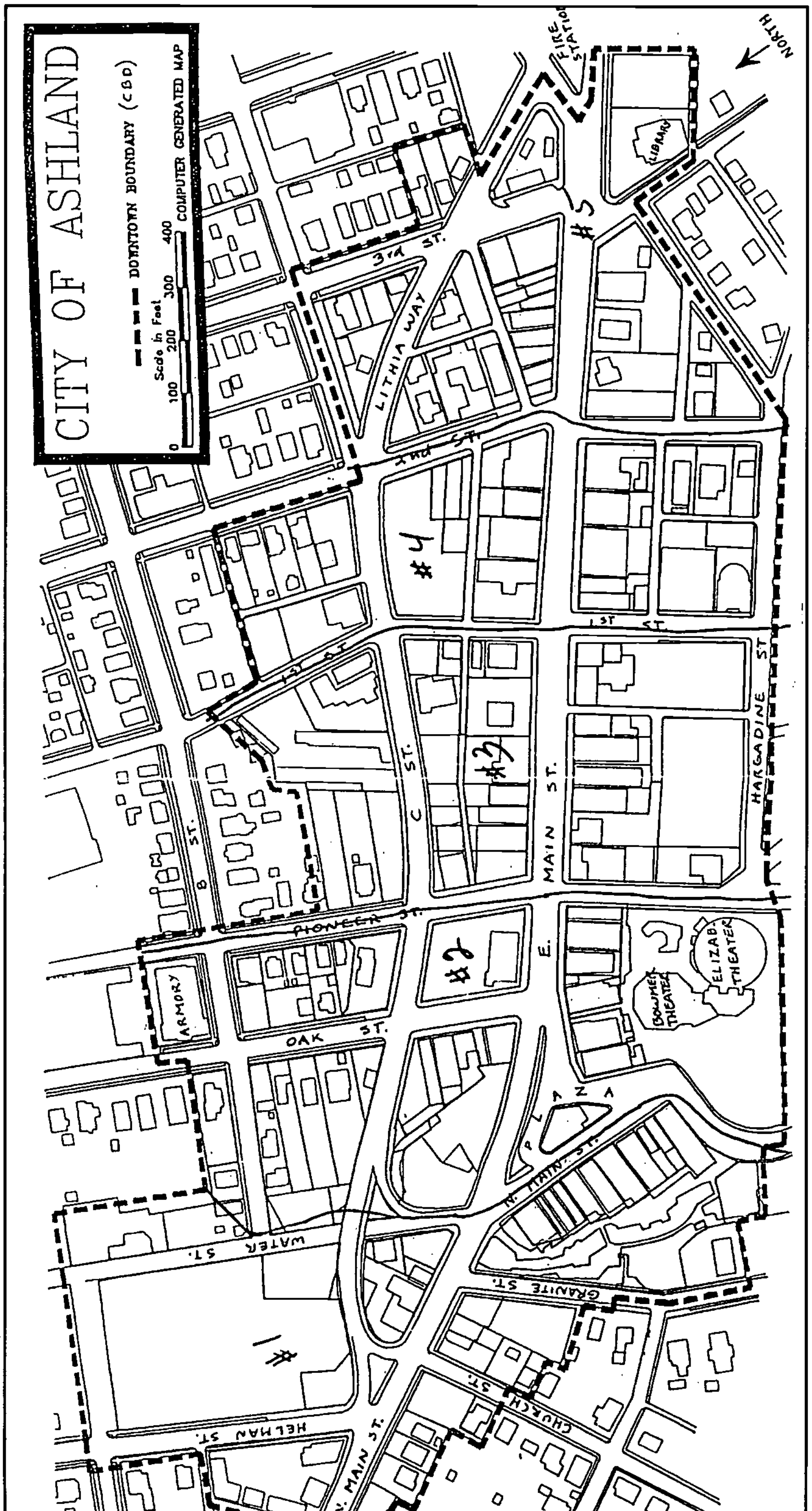
(Adapted from fieldwork designed by John Mairs at Southern Oregon University for use by the Oregon Geographic Alliance)

CENTRAL BUSINESS DISTRICT:
Street-level function and footage

Keep track of the number of each type of function you find on the street.

Measure the street frontage of each establishment. Record the total street frontage for each function category.

Map of the City of Ashland



Central Business District Tally Sheet: Street Level Function and Footage

Establishments:	Number of Establishments	Length of frontage for each	Total frontage Feet
RETAIL GOODS			
Antiques			
Apparel: General			
Apparel: Children			
Apparel: Men			
Apparel: Women			
Apparel: Sport			
Apparel: Shoe			
Art (sales; framing)			
Auto parts			
Bookstores			
Camera			
Drug store; variety			
Stationary			
Electronics			
Food: processing			
Food: specialty			
Florists (gifts)			
Gifts; souvenirs			
Glass (windows; mirrors)			
Jewelry			
Liquor; wine shops			
Lumber			
Music (recorded; instruments)			
Print, copy shops			
SERVICES			
Contractors (construction; landscape)			
Financial (non-bank)			
Hair care			
Insurance			
Legal			
Medical (doctors; dentists, health)			
Newspaper offices			
Professional offices (lawyers; CPAs, etc.)			
Real estate sales			
Tourist services, guides			
Utilities			
RESTAURANTS			
TAVERNS; BARS			
AUTO SERVICES			
REPAIR SHOPS			
HOTEL, MOTEL, B&B			
THEATERS (RECORDED; LIVE)			
TRANSPORTATION			
CHURCHES; SOCIAL ORGANIZATIONS			
PUBLIC OFFICES, LIBRARY, MUSEUMS			
PARKING LOTS			
PARKS			
RESIDENTIAL			
VACANT SHOPS			
VACANT FRONTAGE			
WAREHOUSE			

Fieldwork #10

Urban Transportation: A Public Transit Survey

Overview: Students will explore the urban landscape and land use changes in the urban environment by riding public transit. They will compare their observations about the landscape with their knowledge of three classic models of urban land use, and they will draw conclusions about urban growth and land use in their own city. The map that follows this lesson shows the route taken by students in Portland, Oregon, on the Portland light-rail system; it runs from the densely-developed urban center to the farmland on the urban growth fringe. Any similar route that takes students through a variety of urban built environments is suitable for this fieldwork. If the students take the same route both directions, they can focus on one side of the street or rail on the way out, and on the other side on the way in.

Grade Level: Upper middle school through high school

National Geography Standards addressed:
#12. The processes, patterns, and functions of human settlement
#15. How physical systems affect human systems
#18. How to apply geography to interpret the present and plan for the future

Connection to Advanced Placement content:
VI: Industrial and Economic Development
VII: Cities and Urban Land Use

Objectives:
Students will
a) hypothesize about land use change and its relation to urban transit, focusing on questions of location, routes, and patterns.
b) observe land use change along an urban transect.
c) compare their observed findings of land use change with models of land use change discussed in class.
d) sketch and write about their field observations and report on their urban land use findings.

Materials and equipment:
Clipboards and writing implements for sketching
Field logs
Bus tickets (many transit authorities give discounted or free passes to students)

Procedures:
In-class preparation: Students need to be introduced to the models and vocabulary of urban geography related to urban zonation (see examples attached). Students should also familiarize themselves with the route to be traveled and get some sense of the patterns they might expect to see. They can hypothesize about what they will see, and develop theories about why certain land uses occur where they do.

For younger students it may be useful to give them some guided questions to answer about the route. You will need to tailor the questions to the particular route.

Sample questions, used on the light-rail route in Portland, include:
What bridge did we take across the Willamette?
Why was the Burnside route chosen for the light-rail system?
Why is there a big turn at 122d St. in an otherwise fairly straight route?

Data Collection: Students will board public transit at one end of the route they will take. As they move along the route, they will sketch land use and make field notes concerning the types of land use, density of land use, and factors that might cause land use change along the route. In addition to changing patterns of land use, students should note and attempt to define changing economic regions. They should also make and note additional observations that add to the wealth of the information about the urban landscape, such as differences in age of buildings, relative number of trees and parks, and major or minor transit intersections.

Upon returning to the classroom, students can post their sketches, and compare observations. Students should discuss whether their city fits any of the urban models discussed in class. They can also discuss why the transit system followed the route it did (this is especially useful when using light-rail, as opposed to a bus system, since physical or cultural considerations often restrict light-rail routes).

Specific questions the students can consider include:

- Would public transit be an asset or a detriment in the following areas:
  Residential neighborhoods?
  Light commercial areas?
  Industrial areas?
  Mixed use areas?
- Can you predict how specific areas along the route might look different in 10 years (and why)?
- What are the strengths and weaknesses of the present public transit system?

Presentation suggestions: In addition to posting field sketches, students can prepare detailed maps of the route they traveled, including the information from all their observations.

Extensions:

1. Many cities are in the process of designing new mass transit routes; students can predict the course of those routes, or offer suggested routes based on their knowledge of the city.
2. Using historical maps, students can investigate abandoned transit routes and discuss the urban development processes that might have caused abandonment. In some cities, rails have been converted to trails, offering an ideal site not only for historical research but for a good hike!

Examples of Urban Zonation

Different models use different terms for zones in the urban environment. Some examples are:

Central Business District (CBD): Traditional center of a city; downtown, the commercial core where goods and services are offered for sale in a dense collection of establishments; usually the oldest part of a town, where land values are highest.

Transition Zone: An area changing from one principal use to another. Usually has a mixture of older, established industries, some shops and services, and relatively low quality housing.

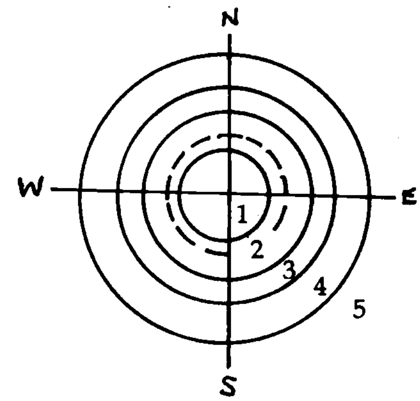
Low-income Residential: Houses often built on small lots, older houses, houses in need of repair (fixer-uppers).

Moderate-income Residential: housing two-to-five decades old; some semi-detached properties, large lots with moderate landscaping and gardens; often in the transition area of urban to suburban.

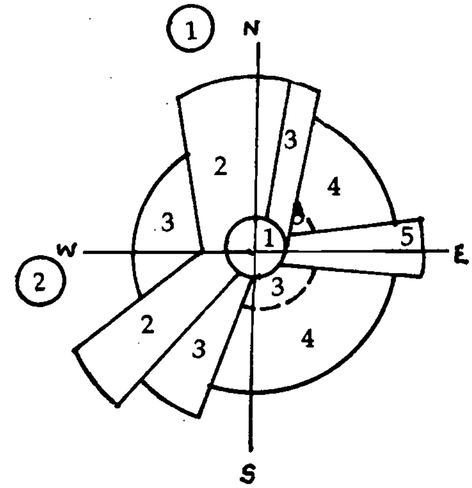
High-income Residential: Large, detached properties, significant landscaping and gardens; often at urban fringe.

Models of Urban Land Use

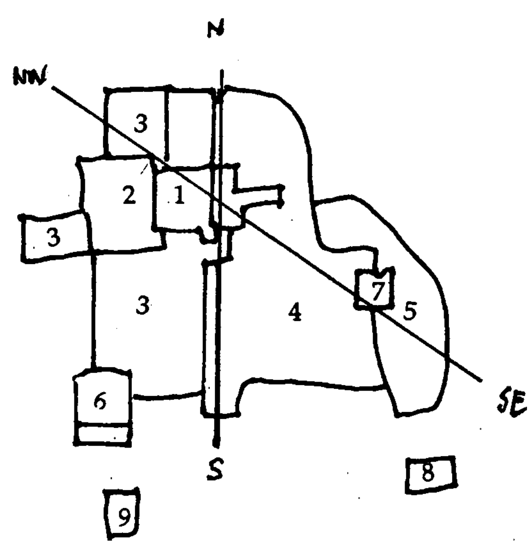
Burgess's Model (Concentric Zone Theory)
1. Central Business District (CBD)
2. Transition Zone
3. Low-income Residential
4. Residential Zone
5. Commuter Zone



Hoyt's Model (Sector Theory)
1. Central Business District (CBD)
2. Wholesale Light Manufacturing
3. Low-income Residential
4. Moderate-income Residential
5. High-income Residential

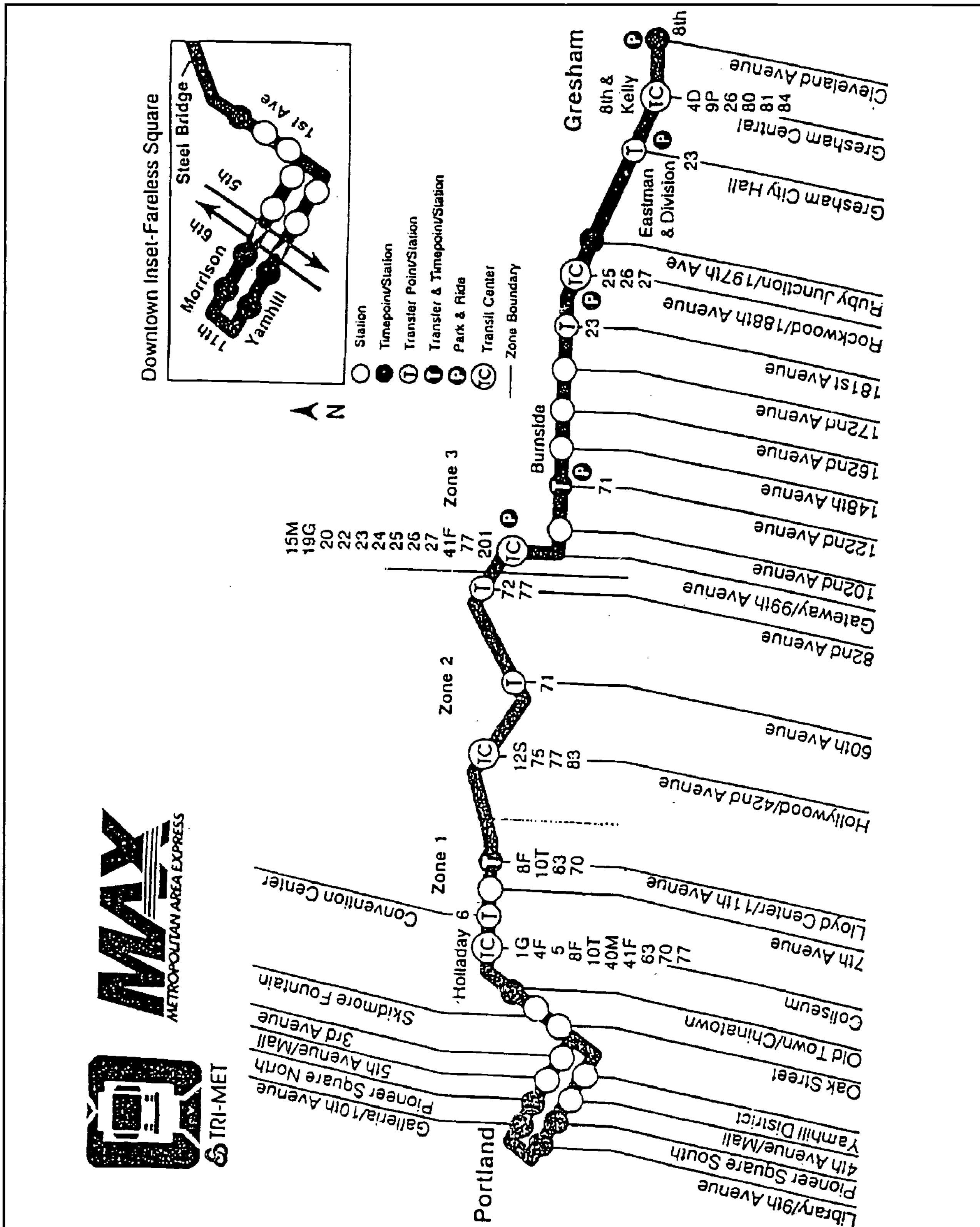


Harris's and Ullman's Model (Multiple Nuclei Theory)
1. Central Business District (CBD)
2. Wholesale Light Manufacturing
3. Low-income Residential
4. Medium-Income Residential
5. High-Income Residential
6. Heavy Manufacturing
7. Outlying Business District
8. Residential Suburb
9. Industrial Suburb



Source: After Chauncy D. Harris and Edward L. Ullman 1945. *Annals of the American Academy of Political and Social Science,* CCXLII (November) 7-17.

Map of Metropolitan Area Express



Fieldwork #11
Analyzing the Local Shopping Mall

Overview: Most students have well developed mental maps of their neighborhood shopping mall and can find their way to the local GAP Store blindfolded! Teachers can tap into this geographical awareness by using the mall as a fieldwork site for studying an array of geographic phenomena, particularly those pertaining to economic interdependence and land use decisions.

In this fieldwork, students examine the location of the mall in the community, survey shoppers to determine shopping and traffic patterns, and analyze spatial relationships between the different types of retail establishments. Preparation done in the classroom prior to going out to the field is critical as is the work done after they have gathered their data. Students need to have context in which to place their findings. This activity is designed primarily for students in grades 6 to 8 but could easily be extended to those in higher grades.

National Geography Standards Addressed:
#3. How to analyze the spatial organization of people, places, and environments.
#11. How to analyze the patterns and networks of economic interdependence.

Grade level: 6-8

Objectives: Students will:
a) analyze the location of the mall in their local community with regard to accessibility and transportation networks;
b) identify, classify, and map the types of retail stores located in the mall;
c) identify and analyze shopping patterns among customers using the mall;
d) identify and determine the *trade catchment area* for the mall.

Materials and equipment:
Maps of the community showing the location of the mall, transportation networks, and zoning designations.
Maps of the area showing land use before the building of the mall.
Air photos of the area.
Outline maps of the mall layout
Clipboards.

Procedures:
1. After discussion about the function and role of the mall in their community, assign students to one of four major fieldwork areas that focus on the:
   - location, history, and design of the mall;
   - mapping and classification of retail establishment including the location of *anchor* (principal) stores;
   - shopping patterns of customers; and
   - identification of the *trade catchment area* of the mall.
2. Students in each of the four groups brainstorm ideas and identify key geographic questions they can investigate for their particular area. Some examples of geographic questions could be:
   - Where is the mall located in terms of absolute and relative location?
   - Why did developers choose this particular location?
   - What was the previous use of the land?
   - How old is the mall?
   - What types of retail establishments are found in the mall?

- Is there a pattern to the location of types of stores?
- Are certain types of stores clustered in the same area?
- What are the *anchor* stores in the mall and where are they located?
- What is the traffic pattern in and out of the mall?
- How far away are the shoppers who come to the mall?
- How do they travel to the mall?
- How often do they come to the mall—in a week or month or year?
- If you were a prospective storeowner, where would locate your store and why?

3. Each group identifies and designs appropriate strategies for collecting data in order to answer their particular geographic question(s)—surveys, mapping, tally sheets, interview questions, indexes, retail establishment classification systems. etc. The teacher might provide students with models and should evaluate and check the data collection sheets, map outlines, surveys, etc. before students can use them in the field.
4. Students collect the data at the mall.
5. Upon returning to the classroom, students organize the data collected using maps, charts, graphs, photos. etc. They analyze their results and present their findings to the rest of the class.
6. The teacher facilitates the discussion of findings and analysis through a series of questions summarizing the key findings and asks students to speculate on the future role of malls in the community.

Adaptations:

1. Teachers can adapt this fieldwork for upper elementary students. The students, however, would need more direction and guidance from the classroom teacher.
2. Teachers can use Farmers' Markets and Flea Markets instead of malls.

Fieldwork #12

The Busy Street: Traffic Flow Survey

Overview: Participants will study traffic congestion in urban centers or in their school neighborhood by conducting a survey of the volume and type of traffic occurring at a key intersection of streets during specific times of the day. The activity could be part of a unit dealing with the development of cities and industrialization or it could be part of a study of the local community. The results of the survey might lead to a discussion and subsequent request for a new pedestrian crossing, additional crossing guards during school hours, or the installation of a new traffic light.

National Geography Standards Addressed:
#3. How to analyze the spatial organization of people, places, and environments.

Grade level: K-6

Objectives: Over a specific time period, participants will:
a) count the number of vehicles passing through a particular intersection; and
b) identify and classify the types of vehicles observed.

Materials and equipment:
Grade 3-6
Charts with columns for different types of vehicles (trucks, cars, taxis, motorcycles, buses, etc.).
K-2
Charts with pictures of different types of vehicles.
Clipboards.

Procedures:
1. In the classroom, before going out to conduct the survey, students brainstorm ideas about where they think traffic congestion might occur in the school neighborhood, when it is most likely to occur, and the type of vehicles they are likely to encounter. The discussion might also focus on the rise and role of the automobile in our society.
2. Students are given instructions and practice on how to gather the traffic data once they are in the field. Students may be assigned to work in pairs.
3. Each participant, or pair of participants, is given a chart with columns for different types of vehicles (trucks, cars, taxis, motorcycles, buses, etc). For the K-2 level, the chart will contain pictures of the types of vehicles.
4. Each participant or pair is assigned a particular type of vehicle to observe.
5. During a five minute (or longer) period, participants record the numbers of their assigned vehicles.
6. In the classroom, students create graphs (pictographs for the K-2 level) of their data.
7. Teacher leads the discussion of findings and analysis through a series of questions:
- What did you find out?
- What type of vehicles were most common and why?
- How would the traffic be different on a weekday, at weekends, or at different times of the day?
- From where do the vehicles come?
- Are there any traffic congestion problems? If yes, what can we do about them?

Extensions:

1. Conduct traffic flow counts at the same spot at different times of the day to compare traffic patterns.
2. Conduct traffic flow counts at several different locations in order to compare patterns and identify possible congestion spots.
3. Carry out a survey of pedestrians to identify how many people travel in and out of the area, identifying the type of transportation that they use.

Traffic Survey Data Sheet

Name: ______________________________

Date: ____________________ Day of the week: ____________________

Time start: ____________________ Time finish: ____________________

Cars	Trucks	Vans	Motorcycles	Police Cars	Other

Fieldwork #13
Urban Sleuthing Using Maps, Aerial Photography, and Fieldwork

Overview: This project introduces students to basic map identification skills, historical map comparisons, and photo interpretation. The fieldwork focuses on using documentary materials to identify and analyze historical and current urban patterns and changes in land use, buildings, and infrastructure.

Grade Level: High school

National Geography Standards addressed:
- #1. How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective
- #3. How to analyze the spatial organization of people, places, and environments on Earth's surface
- #4. The physical and human characteristics of places
- #12. The processes, patterns, and functions of human settlement
- #14. How human actions modify the physical environment
- #17. How to apply geography to interpret the past
- #18. How to apply geography to interpret the present and plan for the future

Connections to AP Content:
- VI: Industrial and Economic Development
- VII: Cities and Urban Land Use

Objectives:
Students will:
- a) Observe a selected area of an urban environment to test hypotheses about land use change
- b Collect information and record field notes to understand changes that have taken place in the urban landscape
- c) Do field mapping and create manual GIS (Geographic Information System) street overlay(s)
- d) *Ground truth** aerial photography and maps (Ground truth*—data obtained on the ground to guide computer-assisted interpretation of remotely-sensed data.)
- e) Interpret, analyze and draw conclusions from data to explain the changes in an urban landscape

Materials and equipment: Check with your school or town librarian for the mapping and photographic materials. City and county offices, or local historical societies, may also have this material available. Materials for each group include:

Color infrared aerial photographs of a section of your city or town
1890s Sanborn insurance maps
Street map of the area to be investigated
Overlays
Magnifying glass
Pencil
Red pen
Black pen
Note paper
Clipboard
Butterfly clip

Introduction: The exercises in this fieldwork show how to do fieldwork using maps, aerial photography, observation, and analysis to answer a geographic question. Historical maps, such as old plat maps or Sanborn insurance maps, are records of time periods for which we can use these images for comparison with other maps and with aerial photography. Other maps such as street maps and topographic maps show general orientation, topography, and prominent features. Aerial photographs are actual images of what is on the surface of the earth. We can use these images for recording information, location, and annotating information on the ground.

Procedure:

In-class preparation: Comparison of maps with aerial photography:

Students should prepare the maps and photographs for use in the field. Using the maps and photographs students can suggest hypotheses to be tested in the field concerning land use change. Before beginning, have students figure out the scale of the maps they are using (Sanborn maps are often approximately 1:1,400 or 1" represents 116 feet).

1. Orient street map and aerial map:
   a. Locate *north* on the street map (you may need to use a state road map to orient the street map).
   b. Locate street patterns, shorelines, or other features on the street map.
   c. Orient the photo to *north*.
   d. Note the difference in scale between the street map and the aerial photograph. Find the same identified features on the aerial photograph.
2. Create street map overlay on city map.
   a. Place a clear film overlay on top of the street map.
   b. Tape the overlay at the top edge.
   c. Use the red pen to draw and label the key streets in the area you investigated. The streets should form an enclosed form (such as a rectangle or triangle or any other enclosed shape).
3. Create street map overlay on the aerial photograph.
   a. Place a clear film overlay on top of the aerial photograph.
   b. Tape the overlay at the top edge.
   c. Place a north arrow at appropriate center edge of photo.
   d. Use the red pen to outline (that is, draw along both sides of the street) and label the same key streets.
4. Create building overlay on the aerial photograph.
   a. Place a second clear film overlay on top of the aerial photograph.
   b. Tape the overlay at the top edge of the aerial photograph and over the street overlay.
   c. Register overlay with aerial photograph. Use two corners, a park, or large structure to register.
   d. Use red pen to outline buildings within the area of streets identified on the street overlay (use magnifying glass, if necessary).
5. Create map on overlay of same street on the Sanborn map.
   a. Place a clear film overlay on top of the Sanborn map.
   b. Tape the overlay at the top edge of the map.
   c. Use black pen to outline (mark both sides of street) and label the same key streets as above.
6. Compare the Sanborn map to the aerial photograph for the area to be investigated.
   a. Compare the Sanborn map to the aerial photograph. Using the overlay on the Sanborn map, cross-hatch in red in the area to be investigated all the buildings from the Sanborn map that also appear on the aerial photograph.
   b. Cross-hatch within the area, in black, all the streets that appear in the aerial photograph that are **not** on the Sanborn map.
   c. What changes to you see? How can you explain the changes?

In the field: Before heading into the field, tape another clear overlay on the Sanborn map, on top of the street overlay.

1. Pace and estimate distances of each block and building front in the area. Use the red pen to map buildings within the area. Name buildings mapped and note any dates for building construction.
2. Where possible, enter buildings and identify current use; interview people where possible.
3. Write observations and other relevant information on overlays or in field logs. For selected stops and observation sites, record the following information:
   a. time and date,
   b. proximal location (include city, state, street address if known, cross street and any other pertinent information),
   c. field sketch notable markings or other interesting objects,
   d. write descriptions, other information (such as interview notes), impressions, and suppositions,
   e. annotate photography and maps (use overlays).

Analysis: In analyzing their fieldwork students should do at least the following:

1. Review maps, photography, and notes of observations and findings.
2. Draw conclusions and discuss results of the hypotheses tested.
3. Compare field observations with aerial photograph and map observations to analyze:
   a. What information did the fieldwork provide that was not available from the maps and aerial photographs?
   b. What information did the Sanborn map provide that was not available on the aerial map or from the fieldwork?
   c. What information did the aerial photograph provide that was not available on the Sanborn map?

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